ST. BARTHOLOMEW'S HOSPITAL JOURNAL

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ST. BARTHOLOMEW'S HOSPITAL JOURNAL

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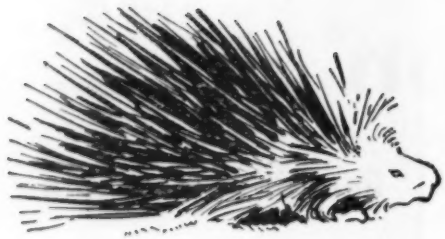

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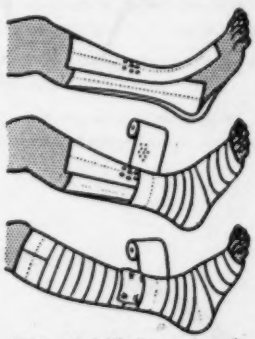

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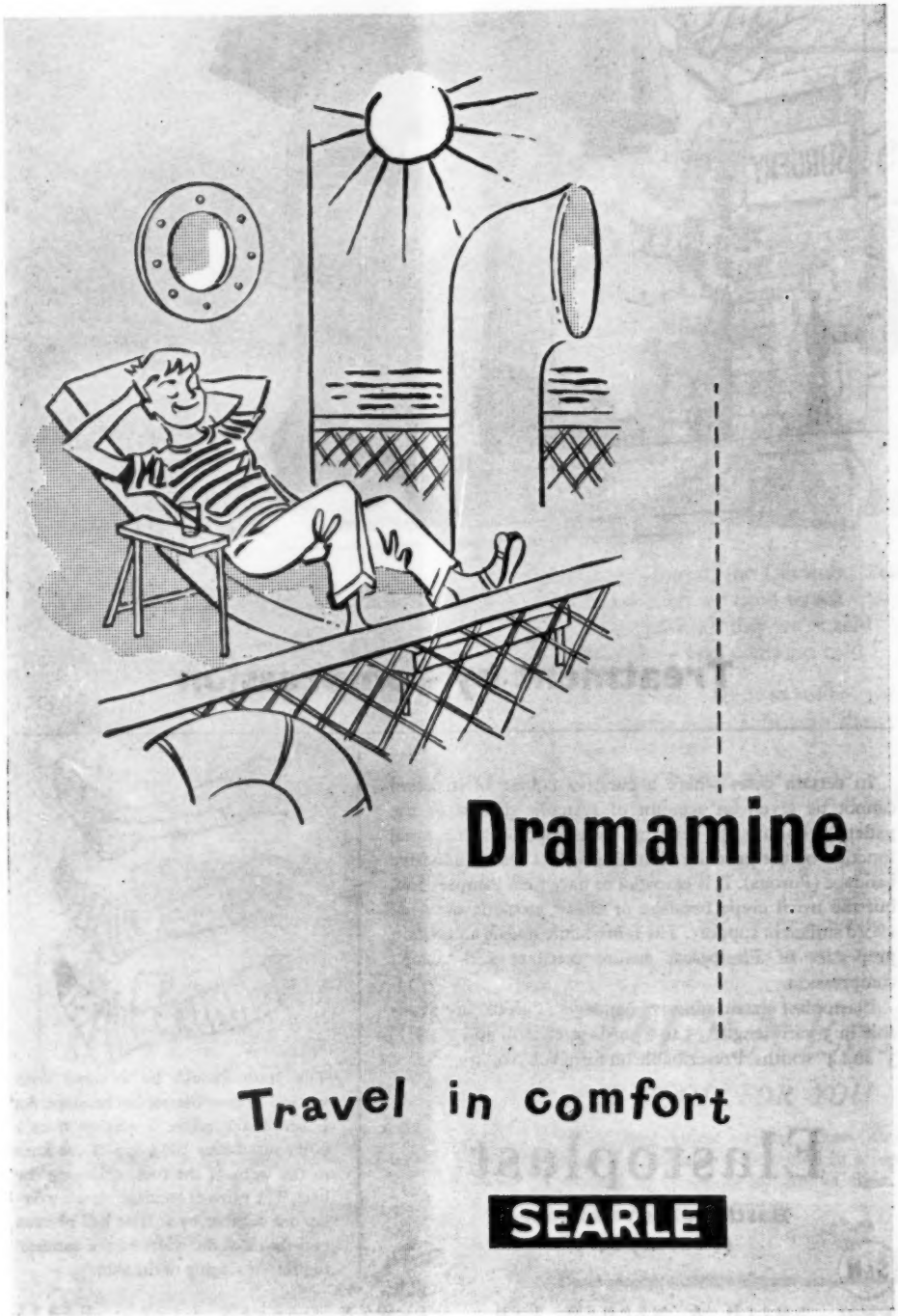
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ST. BARTHOLOMEW'S HOSPITAL JOURNAL

Vol. LXI **JUNE 1957** **No. 6**

A symposium
to commemorate the tercentenary of the death of
William Harvey on 3 June, 1657

EDITORIAL

IN JUNE OF 1928 the *Journal* commemorated the tercentenary of the publication of William Harvey's *Exercitatio De Motu Cordis et Sanguinis in Animalibus*. In June of 1957 we commemorate the tercentenary of the death of its author. There is little need of excuse for devoting time and thought to the great men of the past; in the case of William Harvey, the most eminent physician ever to minister to the sick of our Hospital, there is no need for excuse at all.

* * *

The bald statement of a discovery is as informative as a tombstone. It tells you a fact which you knew already, or in which you have not the slightest interest. But even a brief digression into history may turn the fact into an absorbing study of human behaviour, perhaps even an inspiration. We may enquire whether the discovery was a flash of insight or the result of many years of patient study; why the man attempted to make the discovery and why he was successful; what effect the discovery had on himself, his wife, his contemporaries; how his predecessors had managed to cope without his new knowledge; and, perhaps more important than any of the myriads of questions that one might ask, what sort of man he was and what sort of life he led that enabled him to succeed where so many others had failed.

One less important query, which we will take an editorial license in considering, is what would have happened if the discovery had not been made. In Harvey's case this is quite clear. The spread of microscopy shortly after his time would soon have led to the discovery of the one piece of evidence lacking for his theory; namely, the means by which the blood gets from the arteries to the veins. (In fact, capillaries in the lung of a frog were demonstrated only four years after Harvey's death by Malpighi.) But if the discovery of the circulation of the blood had been made in this way, it would have been made entirely by the old and established method of observation, acceptable in the Western world since the time of the Greeks. Probably as a result, the fact would have been accepted more quickly by the physicians of the time. But the immense propaganda for Harvey's new methods of research would have been lost. As it was, Harvey demonstrated the circulation by experiments on animals and men. His contemporaries had to swallow the circulation of the blood and the respectability of experimental medicine in the same pill.

It has been alleged, rather cruelly, that Harvey as a good Aristotelian derived the idea of the circulation from the current concept of the circle as the perfect geometrical form; although it would take a very ardent Pythagorean to find anything very circular in the cardiovascular system (*pace* the Circle of Willis and, of course, the vessel walls). But the general idea of circulation must have been in men's minds at the time. In 1543 Copernicus, another graduate of Padua's medical school, published his *De Revolutionibus Orbium Coelestium* in which he set forth his heliocentric theory of the solar system. And in 1609 Kepler made known his calculations on the elliptical circulation of the planets. Another circulatory problem was the meteorological one of rainfall, in which evaporation of water from the sea played the part of the invisible capillaries. More pertinent, perhaps, was Servetus' theory of the pulmonary circulation (*Christianismi restitutio*, 1553); and, of course, Fabricius pro-

vided a direct stimulus by interesting Harvey in his work on venous valves.

Perhaps one reason why Harvey's discovery met with such opposition is that it required a complete reorganisation of men's views about the contents of their own bodies; and any idea which violates a man's habitual picture of himself is bound to be distasteful. Only recently they had been told that they were not sitting snugly at the centre of the universe, but rather that the ground they stood on was rushing around the sun at an almost inconceivable speed. Now they were asked to believe that the blood inside them was rushing round and round in a quite unheard of way, instead of ebbing and flowing sluggishly as Galen had assured them. This remained perhaps the greatest blow to their equanimity until Freud demonstrated the strange contents of their unconscious minds.

* * *

The intrinsic interest of Harvey and his discovery is only one reason for presenting this symposium. A fundamental function of the *Journal* is to publicise the interests and publish the researches of members of the Hospital; and we are fortunate in having at the present time many Bart's men who are not only interested in but also carrying out active research into the life and works of Harvey. This has dictated to some extent the form of the symposium. It is not a systematic survey of the subject, but rather a collection of articles by experts on their own particular fields. However, in the pages that follow will be found answers to many of the questions that we have asked.

We would like to express our appreciation to our many contributors, who have found time to write for us in a year in which the time of every Harvey scholar is in very great demand.

View Day Exhibition

The Archivist and Librarian are to be congratulated on the fine display of manuscripts and first editions which was on view in the Great Hall on May 8th. Those who were aware of the Tercentenary paid special attention to the Minutes of the Governors' meetings, which contained references to Harvey's salary, etc., and also to a page of manuscript in which he mentions his experience in the Hospital. Our main reaction was one of respect and sympathy for those who translate his mixed Latin and English and read his practically illegible handwriting.

Many of the documents quoted by Miss Stokes in her article on page 167 were on view, and she tells us that they will probably be on view again during the week of June 3rd.

The log fire in the Great Hall added to the pleasure of the exhibition, and made a pleasant refuge from the somewhat chilly social activity in the Square.

. . . . on the playing-fields of Bart's.

Easter Concert

This was a most enterprising and enjoyable concert given in St. Bartholomew's the Great on April 9, by the Rahere Music Society of St. Bartholomew's Hospital. The works ranged from two motets of the pre-Bach era to Mozart's Requiem, by way of

a fine performance by Anne Cassal of Bach's vigorous organ Prelude and Fugue in A minor, one of his chorales from the St. Matthew's Passion and two lesser known chorales.

The motets by H. L. Hassler and J. H. Schein—almost unknown music of great beauty and drama—were sung most convincingly by the choir and in these the balance of parts was at its best.

The choir sounded more tentative in the chorales, perhaps owing to their considerably slower speed, but there was some beautiful solo singing and choral effects.

The requiem was performed with warmth and spontaneity and the conductor Richard Sinton and orchestra should be congratulated on their excellent accompaniment, fully supporting but never drowning the singers. Most of the choruses sounded very well, although the altos and tenors needed more body at times. The soloists—Alice Bohdjalian, Hilda Bickley, Brian Richards and George Hobday—tackled their difficult parts most creditably.

Altogether, this was a memorable evening in surroundings not unlike those in which most of these works had their first performances.

Thanks are due to Richard Sinton and to the Rahere Musical Society for the scholarly musicianship as well as the intensive work which made such a concert possible.

Osseous Librarian

We wish all success to B. W. D. Badley, who recently fought a noble battle on television for the educational benefit of his successors. On the programme *State Your Case* he claimed £100 to start a bone library; and while the cameras were making technical similes between his prosecuting counsel and a skeleton, he argued the case for the medical student who does not want to buy his own bones. Let us hope that the viewers see the logic of the point—and anyway, you can't even get them on the never-never.

Journal Staff

Applications are invited for the posts of Assistant Editor and Women's Representative.

The post of Assistant Editor is held for six months and is usually followed by a six months editorship. Applicants should preferably be in their first clinical year.

That of Women's Representative is advisory rather than administrative and is therefore not exhausting. It is open to ladies of any seniority and may be held indefinitely.

Applications should reach the Editor by June 20.

CALENDAR

Tue.	June	4	Athletics: v. Harrow School and Scarabs (A).
Wed.	,,	5	Athletics: v. Dulwich College and St. Mary's Hospital (A). Golf: v. St. Thomas's at South Herts.
Sat.	,,	8	Medical and Surgical Professorial Units on duty. Anaesthetist: Mr. G. H. Ellis. Tennis: v. King's College Hospital (H). Sailing: First Heats of Sherren Cup.
Sun.	,,	9	Cricket: v. Queen's College, Cambridge (H).
Mon..	,,	10	Sailing: Final of Sherren Cup.
Thur.	,,	13	Oxford-Bart's Club sherry party.
Sat.	,,	15	Dr. G. Bourne and Mr. J. B. Hume on duty. Anaesthetist: Mr. F. T. Evans. Tennis: Mixed doubles tournament. Sailing: Interhospital race. Athletics: United Hospitals Championship at Motspur Park.
Sun.	,,	16	Cricket: v. Horlicks (A).
Wed.	,,	19	Tennis: v. West Heath L.T.C. (mixed) (A). Golf: v. City Police at South Herts.
Thurs.	,,	20	Sports Day Heats.
Sat.	,,	22	Sports Day. Dr. A. W. Spence and Mr. C. Naunton Morgan on duty. Anaesthetist: Mr. R. A. Bowen. Cricket: v. Royal Dental and Charing Cross Hospitals (A). Tennis: v. St. Thomas's Hospital (H).
Sun.	,,	23	Cricket: v. Barcome (H).
Wed.	,,	26	Golf: v. Guy's at Shirley Park.
Thurs.	,,	27	Athletics: relay meeting.
Sat.	,,	29	Cricket: v. Jesters (H). Tennis: Tournament finals.
Sun.	,,	30	Cricket: v. Old Roans (H).
Wed.	July	3	Tennis: v. King's College Hospital (A). Golf: v. Middlesex Hospital at South Herts.

WILLIAM HARVEY

by SIR GEOFFREY KEYNES

DR. WILLIAM HARVEY died on the third of June three hundred years ago and commemorative meetings are taking place this week in London and elsewhere. Celebrations were held in 1928 to commemorate Harvey's name but this was for the tercentenary of the publication of Harvey's first book, *De Motu Cordis*, in which he announced his demonstration of the facts of the circulation of the blood in the veins and arteries of the mammalian body. The volume consisted of only thirty-eight leaves, was printed on bad paper, was full of typographical errors, and was published at Frankfort instead of London. It has nevertheless been recognized as one of the most significant books that has ever come from the press, being the beginning of modern experimental science, of current physiological concepts, and so of the advance of medicine to its present position.

In 1928 we commemorated an idea; in 1957 we think rather of the man who elaborated the theme and died in his eightieth year as the most eminent member of his profession in England. For in order to gain an idea of Harvey's position in the seventeenth century world it is important to realise that he was primarily a practising doctor, physician for thirty-six years to St. Bartholomew's Hospital, personal physician to two kings, and not so disinterested a scientist that he could refrain from complaining that, owing to his reputation as a dangerous innovator, reduction of his private practice was hurting his purse. Nevertheless, his ruling passion was a tireless search for scientific truth in the field of biology, coupled with a marked reluctance to publish the results of his work and a cool indifference to the hostility provoked by the novelty of his ideas when publication had taken place.

We can have no knowledge of how Harvey's intellect developed as a schoolboy at the King's School, Canterbury, as an undergraduate at Caius College, Cambridge, or as a travelling student in France and Germany. It was only when he became enrolled as a student at the University of Padua that his intellectual distinction became apparent, and recent discoveries hint that it was not until he had studied for a while at Padua that he decided to embrace medicine, having up to this point looked at general philosophy rather than any particular discipline. But at Padua he came into contact with Fabricius, the most eminent anatomist of his time, and from him learnt of the existence of valves in veins. According to his own statement made later in conversation with another great scientist, Robert Boyle, he noticed that these valves "were so placed that they gave free passage to the blood towards the heart, but opposed the passage of the venal blood the other way" and this suggested to him the truth, that the blood must move forever in a circle from heart to arteries to veins and back to heart again. Harvey was well versed in the doctrines of Aristotle and Galen, but rejected finally erroneous assumptions that the blood ebbed and flowed in the great vessels, or that it passed from one chamber of the heart to another through holes in the partition between them. Nevertheless, he remained to some extent Aristotelian in his thought to the end of his life; though he rejected the doctrine that the *heart* was the seat of the soul, he still spoke of the *blood* as "a generative part, the source of life, the first to live and the last to die, the primary seat of the soul."

The great John Hunter, late in the next century, is always credited with the laconic advice, "Why think? Why not try the experiment?" but it was Harvey who had first, since Galen, acted on this principle and proved by direct experiment that the blood moved in a circle successively through the lesser circulation of the right side of the heart and the lungs, and then through the greater circulation of the left side of the heart and the great systemic vessels. The MS notes of his Lumleian Lectures delivered at the College of Physicians are extant and carry the date 1616. Two pages of these notes, including the famous sentence: "It is plain from the structure of the heart that the blood is passed continuously through the lungs to the aorta as by the two clacks of a water bellows to raise water," summarise Harvey's revolutionary views on the circulation and it has usually been assumed that it was in 1616

Reprinted from *The Times*, 3 June, 1957, by kind permission of the Editor.

that these views were first promulgated. It has been noticed, however, that these pages were, from the evidence of the handwriting, penned at a different time from the rest of the MS and were probably added later, so that the exact date of the first announcement remains uncertain; but the operative date is 1628, when Harvey's incisive mind cut through the trammels of tradition and orthodoxy with the arguments and their experimental proof contained in the few pages of his book. This is still regarded as one of the most perfect examples of deductive reasoning based on experiment that has ever been printed, and it is for this reason that Harvey's triumphant demonstration of scientific method in biological research is to be regarded as his greatest achievement rather than his discovery of the circulation of the blood. Yet, with all his perspicacity and scientific acumen, Harvey's concepts were inevitably limited by the lack of apparatus to which any investigator working in the first half of the seventeenth century was subject. He could see the arteries conducting the blood from the heart getting smaller as they neared their destinations; he demonstrated the return journey towards the heart through the veins. But of the actual communications of the two systems in the lungs or other tissues through the tiniest vessels, or capillaries, he could have but the vaguest idea without the help of a microscope. He had no notion of the existence of the minute cells, or blood corpuscles, floating in their myriads in the circulating fluid. The science of blood chemistry had not been born. Harvey's second great book, *De Generatione Animalium*, 1651, is almost as important as the book on the heart since it contains so much original experiment and observation on generation and the development of the chick in the fertilised egg, but in the end he became bogged down in futile speculation because he could not, without a microscope, see the spermatozoon and was unable to imagine it.

Harvey lived after the publication of *De Motu Cordis* for nearly thirty years more through the troubled years of the Commonwealth into a somewhat unhappy old age. He occupied many positions of distinction, accompanying the King on his journeys in England and being sent on more than one mission abroad. John Aubrey is responsible for the story that Harvey was present at the battle of Edgehill in charge of the two Princes. He says that Harvey told him that "he withdrew with them under a hedge and took out his pocket book and read" until a cannon ball grazed the ground near him, when he withdrew. This is picturesque, but is not in agreement with the evidence of other witnesses who afterwards claimed to have rescued the Princes. Nevertheless, Aubrey's anecdote conveys the flavour of Harvey's character, for, though said to have been somewhat choleric as a young man—he was of small stature, had a dark complexion and wore a dagger—he carried himself through life with dignity and restraint both in good fortune and adversity. He was deeply grieved by the loss of much of his work during attacks by the Parliamentary mob on the houses of Royalist sympathisers in London. He told Aubrey that the destruction of his notes on insects was "the greatest crucifying that ever he had in all his life." Although he spoke with so much feeling of this loss, other works were also destroyed. He had written on the lungs and respiration, on the brain, on motion and the senses, and on the natural history of many kinds of animals. He had even talked to his friends of endowing a professorship of experimental philosophy at Cambridge, with laboratory and herb garden, but was deterred by the thought that he might be supporting views and doctrines reflecting the religious and political complexion of the Commonwealth which was so distasteful to him. In the end his benefactions were limited to the College of Physicians. The books and the library building which he provided perished in the Great Fire of 1666, but the annual appointment of a Harveian Orator and the holding of a feast at his behest has continued almost without interruption since 1656 to the present day.

In his later years Harvey received the reverence due to the most eminent figure by far in his College and profession, but enjoyment had departed, destroyed by civil strife and the pains of gout. By 1657 he was content to leave the scene, fully aware of the greatness of his achievement, but glad to abandon the lists of controversy and their attendant worries. He was buried at Hempstead in Essex in the chapel built a few years earlier by his brother Eliab, and there the fine bust by Edward Marshall, recently seen to full advantage in the exhibition of portraits at Burlington House, records for posterity the intellectual features of one of England's greatest sons.

HARVEY'S INFLUENCE ON MODERN TRENDS IN CIRCULATORY RESEARCH

by D. A. McDONALD

IDEALLY scientific observation is completely objective. Facts are facts and should be independent of the beliefs of the observer. Unfortunately the history of science shows us that such independence of mind is all too rare. Wrong theory begets distorted observation, and whole systems of error are perpetuated, until someone has the vision and the courage to state what he sees, like the little boy who refused to admire the Emperor's new clothes. If that man in addition can build the coherent edifice of a new and correct theory he is a genius. Such a man was Harvey. Our knowledge of the circulation begins with his disposal of the Galenical myths. Any discussion of Harvey's influence on our present knowledge of the circulation must necessarily concentrate on one or two aspects for his work forms the cornerstone of it all.

That Harvey conceived the idea of the circulation of the blood is not seriously questioned by anyone. Nevertheless the unique contribution he made has been qualified by many, usually on the grounds that the idea was by no means new. Servetus in the previous century had suggested that blood passed through the lungs and Foster (1924) has indicated that Caesalpinus certainly had the germ of the idea when he argued that flow in the veins must be toward the heart and that in the arteries away from the heart. His contemporaries, whether they opposed his views or supported them, certainty seem to have regarded them as completely novel. Furthermore, in view of the long sway of the authority of Galen, his ideas were accepted relatively quickly. Many new concepts, even though of minor importance in comparison, have taken as long to come into common currency in recent times.

We may ask "What were Harvey's special contributions that entitle him to the sole credit for the discovery of the circulation?" I would say, firstly, he synthezised all the existing evidence to make one coherent and logical whole. Secondly, on the basis of this hypothesis he made planned experimental observations on living animals as an extension of the evidence. Thirdly, he introduced the use of quantitative data when he clinched his argument by showing that the heart must eject each day an amount of blood many times the weight of the body. Hence it must be recirculated.

Singer (1950) has said "although Harvey is, beyond question, one of the great initiators of modern biology, we can also treat him as the last of the classical tradition . . . he stands just on the frontier . . . He is in the new world and yet not of it." Foster makes much the same comment in contrasting Harvey, as the last of the ancients, with Malpighi as the first of the moderns. This judgement is, in part, based on Harvey's constant reference to authority, especially Aristotle, and in this respect is just. Insofar as the great way forward in science was to be by way of the experimental method and of techniques of measurement he was the first of the moderns in physiology even though he did not explore very far in this direction. The criticism of Harvey as a man too much rooted in the classical tradition is, I feel, partly based on the fact that the main theme of *De Motu Cordis* is the development of a logical argument to which the experiments play a secondary role. While agreeing that facts cannot be proved by logic alone, I think that this criticism indicates a narrowness of view. The experimental method alone can lead to a sterile empiricism if treated too austerely. It should be based on broad general theories even if these contain some element of speculation. Harvey's book was so vital because it had the quality of generality.

Cardiac output

Harvey's own estimates of the output of the heart were very inaccurate, although they served the purpose of his argument well enough. Today methods of estimating cardiac output still constitute one of the most

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active fields of research in medicine. Comparison with Harvey imediately reminds us of the technical resources we now have as a result of scientific advance. Yet even here the basic ideas are not so modern as we tend to think. The Fick principle was proposed in 1870, and the great advances of the last ten years or so derive from the germinating idea that samples of mixed venous blood could be obtained by the use of the long plastic catheter. Otherwise the techniques of estimating blood gases and the spirometer are hardly new. The most modern invention in fact, depends on the plastics industry. The intravenous catheter has not only revolutionised the application of the Fick principle to the measurement of cardiac output, but also to the measurement of hepatic blood flow, and by the fertilization of ideas I suppose it could claim some credit for techniques of measuring cerebral and renal blood flow. Nevertheless, it should give us pause to think when we remember that Stephen Hales made remarkably accurate estimates of cardiac output soon after 1700, using techniques that were essentially similar in principle to those of Harvey.

The dye-dilution method of measuring cardiac output is also far from new, even though it has not yet attained a place in most textbooks of physiology. Stewart put forward the principle of the method in 1892, but it was not fully exploited until W. F. Hamilton and his colleagues reintroduced it in the late 1920's, and it was a further twenty years before it was in general clinical use.

Blood-pressure

The measurement of pressures within the circulation has also been the subject of very active investigation. At the time of Harvey the concept of pressure was only just beginning to be developed in physical science, and it is not surprising that he paid no attention to it. Within fifty years of Harvey's death, however, we find that Stephen Hales was conducting a detailed investigation of arterial and venous pressures in a variety of mammals. Very little advance was made after him until the introduction of the mercury manometer by Poiseuille about 1830. In man no method of measuring the arterial blood pressure was available until the development of the Riva-Rocci sphygmomanometer at the turn of the century. Accurate measurement of the pressure fluctuations during the cardiac cycle soon followed with the introduction in 1905, by Otto Frank, of adequate optical manometers designed on the basis of sound physical theory. The application of precise manometry of this sort to man has indeed been dependent on technological advances in the form of strain gauges or capacitance manometers which can be used with thin catheters or needles which minimize trauma and sepsis. The information that has been collected as a result of the availability of these techniques is enormous. Normal and abnormal forms of the pulse wave, the range of arterial blood-pressure variation as a result of disease, or the use of drugs, have been charted in a great number of papers. From this data a certain amount of empirical connection of cause and effect has been made, but most of the information is relatively useless because of the difficulties of interpretation due to a lack of adequate theory. Put in its simplest form we may say that the function of the circulatory system is to distribute blood. To understand how the system is functioning we need to know the flow of blood to the various regions of the body. The knowledge of the pressure changes in the circulation are only of full significance if we can interpret them in terms of flow.

Pressure-flow relationships

We think so much of the advances in knowledge that medicine has derived from the physical sciences that it is gratifying to recall that one of the pioneers in hydrodynamics was a physician — Poiseuille. His name is mainly remembered for the law relating the pressure-gradient to the flow of a viscous fluid in a tube. Poiseuille's meticulously careful experiments on glass capillary tubes established that the flow varied as the fourth power of the diameter of the tube. The fact that it varied linearly with the drop in pressure and inversely with the length of the tube was already established when he published his first results in 1842. Expressed mathematically, the law as determined by Poiseuille was

$$Q = \frac{K.(P_1 - P_2).D^4}{L}$$

(Q = flow ; P_1 and P_2 = pressures at either end of the pipe ; D = diameter, and L = length of the pipe. K = a constant.)

The constant K was shown to vary with temperature and to be different for different liquids; hence it was clearly related to the property of the liquid we call viscosity. However it had no definition in physical units that allowed it to define viscosity. About 1860 a theoretical analysis of the problem was made by the mathematician Hagenbach, and his result was expressed in the form

$$Q = \frac{(P_1 - P_2)\pi R^4}{8\mu L}$$

where μ = coefficient of viscosity. It is this theoretically derived form with which we are familiar. The unit of viscosity has been named the Poise, in Poiseuille's honour.

The derivation of this law is very interesting because it illustrates a beautiful welding of experimental and theoretical analysis. The experimental results were valuable in themselves, but could not be used widely without the general solution in mathematical terms. The mathematics in this case was relatively elementary, certainly in relation to the advances that had been made by the middle of the nineteenth century, but the stimulus to apply them to this important problem came from the experimental work. As a result, physicists tend to regard it as a theoretically derived law and biologists as an empirical law.

Poiseuille's law is only precise for a steady rate of flow of a liquid in a tube of fixed calibre. When the flow is pulsatile the relation between pressure and flow becomes more complex. In arteries and the large veins flow is, of course, pulsatile and so we cannot apply Poiseuille's law. In the capillaries and small veins where the flow is steady, the calibre of the vessels is hard to determine accurately, and the blood shows anomalous viscous properties so that again the law is difficult to apply precisely. Nevertheless, in spite of its limited quantitative value, it would be quite impossible to interpret the behaviour of the arterioles in controlling the peripheral resistance without an understanding of Poiseuille's law, that is to say an understanding of the physical laws determining the flow of liquids in tubes.

For this reason I consider that an investigation of the physical laws determining the behaviour of pulsating flow in elastic tubes to be of great value in advancing our understanding of the circulation. In the Department of Physiology here we have been investigating this problem in recent years. The story bears some resemblance to that of the elucidation of Poiseuille's law in that I first attempted to correlate the pulsatile flow pattern, that was recorded in a large artery such as the femoral of the dog, with the pressure-gradient measured in the same artery. Unfortunately, unlike Poiseuille, we derived no more than a qualitative relationship, but Mr. J. R. Womersley, a mathematician who was very interested in the work, soon derived a theoretical solution. When our data was tested in his formula the results were found to be remarkably accurate. Stimulated by this success he has developed a very full analysis, taking into account the elastic properties of the wall including the attachment of the surrounding tissues to the artery. The behaviour of the wall, as is well known, determines the velocity of propagation of the pressure-wave in an elastic pipe. As a result of Womersley's work we now have a sound physical theory which not only relates a pulsatile pressure-gradient to the corresponding flow, but describes the form of the pulse-wave and also the dilatation of the artery in terms of the pulsatile flow and the pulse-wave velocity. The theory also describes quantitatively the damping out of the pulse-wave in the small arteries and so the conversion of pulsatile to steady flow.

This work is as yet far from complete; many of the theoretical predictions are not yet verified experimentally and on the other hand, the theory does not always fully explain some of the experimental findings. We think that most of these latter discrepancies are due to the fact that the pulse-wave is reflected at the site of arterial branching, and Dr. Taylor in his current work is elucidating this old problem, but for the first time in a quantitative fashion.

This may seem a far cry from the work of Harvey, but I like to think that it is essentially in the same spirit. His great contribution was to synthesize all the known facts together into coherent logical framework. In the present day we need to utilize all the advances in physical and biological science that we can. The theoretical structure that emerges is somewhat forbidding in its appearance. This is to be expected, for we are dealing with a complex physical problem. It is intellectually exciting, however, because it holds out the prospect of enabling us to demonstrate in terms of a general theory the

interdependence of such variables as pressure, flow, arterial dilatation and pulse-wave velocity that are usually studied in experimental isolation. What has been achieved so far has been a group effort. In addition to J. R. Womersley and M. G. Taylor whom I have already mentioned, I should like to record my gratitude to Drs. J. F. Hale and E. P. W. Helps, who did valiant work in the past and have now returned to clinical life. It is unlikely that the results will have any "practical" value in the near future. We are, however, somewhat reassured by Guthrie (1957) who tells us that Harvey was also criticised by some of his contemporaries, "who asked what was to be the *use* of this teaching. Did it really matter which way the blood moved? Had this so-called discovery saved any lives?" In its own humble way present-day research is still trying to solve the problems which have been created by trying to understand fully Harvey's great discovery.

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WILLIAM HARVEY AT BART'S

by M. V. STOKES (*Assistant Archivist*)

"FOR THE LONG service of the said Dr. Harvey to this Hospital and in consideration that he is Physician to his Majesty." These words in the Governors' Minutes of October 15, 1633, almost summarise Harvey's association with St. Bartholomew's Hospital. He had been appointed Physician twenty-four years before, supported in his application by a royal recommendation, and since then he had served diligently, although from 1629 his increasing royal duties had led to difficulties. The solution of these, as well as the steps to his appointment and other administrative matters are all to be found in the Hospital's Journals, the Minutes of the Governors' Meetings. From these official records one cannot expect to learn much of Harvey's medical practice in the Hospital, but they throw light on his relations with the Governors, who seem to have respected him and valued his judgment.

The first appearance of Harvey's name is in the Minutes of February 25, 1609. "This day Mr. William Harvey, Doctor of Physic, made suit for the reversion of the office of the Physician of this house when the same shall be next void and brought the King's Majesty his letters . . . in his behalf and shewed forth a testimony of his sufficiency for the same place under the hands of Mr. Dr. Adkynson president of the College of the Physicians and divers others . . ." The Governors granted his request on the condition that at the death or departure of Dr. Wilkenson, Harvey had no other employment which might hinder his work at the Hospital. Harvey did not have long to wait, for it was on August 28 that year that he came before the Governors again and promised that without payment he would act as Physician in place of "Mr. Dr. Wilkenson late deceased" until Michaelmas when he could then make formal application for the office. On Saturday, October 14, 1609, he was admitted Physician and the Charge of his office was read to him. This is written out in full among the odd memoranda at the end of the fourth Journal. Harvey was to attend twice a week, or more often if necessary, having the sick brought before him in the Hall by the Hospitaler or by the Porter. The Charge continues "And you are here required and desired by us in God His most Holy Name that you endeavour yourself to do the best of your knowledge in the profession of physic to the poor then present, or any other of the poor at any time in the week which shall be sent home unto you by the Hospitaler or Matron for your counsel, writing in a book appointed for that purpose, such medicines

with their compounds and necessaries as appertaineth to the Apothecary of this house, to be provided and made ready for to be ministered unto the poor, everyone in particular according to his disease. You shall not for favour, lucre or gain appoint or write anything for the poor, but such good and wholesome things as you shall think with your best advice will do the poor good, without any affection or respect to be had to the Apothecary. And you shall take no gift or reward of any of the poor of this house for your counsel . . . " For his services he was to receive the annual salary of £25 and from the Ledgers we learn that he also had 40s. for his Livery each year until 1627.

We have no means of telling how many patients Dr. Harvey would see in a week in the Hall, or sent out to his house, for the book containing the prescriptions has disappeared together with the early registers of patients. According to the Indenture of 1546 refounding the Hospital provision was to be made for a hundred poor men and women, but the Hospital had increased since then. The inventories for 1595 list over 190 bedsteads; there were twelve wards when Harvey was appointed and two more, Katherine and Mary Magdalene, were built in 1629. The wards were not all grouped together, some we know were round the Cloister by the parish church of Little St. Bartholomew, once one of the chapels of the Medieval Hospital. The plan of 1617 shows this and the Great Hall where Harvey would have seen patients. The poor were not ill housed; there were curtains to the bedsteads and the inventories indicate an adequate provision of mattresses and bolsters, both feather and flock, sheets, coverlets and blankets of various colours. One ward had a settle by the fire, others had stools and benches. The medicines prescribed by Harvey were prepared by the Apothecary, whose shop or laboratory was built in 1614, not long after Harvey came to the Hospital.

Within a week of his appointment William Harvey's name occurs in the records, but not in connection with his work. The Hospital's Steward, Martin Lewellin, a turbulent character, owed £52 10s. to John Harvey, one of his Majesty's footmen. John Harvey in his petition had been referred to the Lord Mayor and Aldermen, who in their turn called upon the Governors of St. Bartholomew's to end the matter. They called both parties before them and " It appeared that the said Martin Lewellen is bound by his obligation to William Harvey Doctor of Physic brother of the said John Harvey for the payment of the said debt . . . at a day long since past." The Governors ordered that Lewellen's yearly salary of £10 should be paid to William Harvey by 50s. each quarter until the debt was cleared. Presumably this settlement was satisfactory, for we hear no more of the matter.

Five years passed before Harvey next appeared in the Journals. In July, 1614, he asked that he might have one of the Hospital's houses facing West Smithfield. The Governors replied that when William Allen's lease expired they would let the property to Harvey. In 1626 Harvey reminded the Governors of their former grant, Widow Allen being dead. They offered the lease to Harvey at a rent of £13 6s. 8d. if he repaired the house to their satisfaction or at the rent of £20 if the Hospital repaired it; he would hold it as long as he remained Physician and " shall give his personal attendance for the visitation of the poor." This was at the end of March and Harvey was to confer with the Governors in a week. However, the next reference to the matter is on June 9, when Harvey refused to take the house on the Governors' conditions. It seems that they gave him ten days to reconsider, if he did not accept by the 19th, they would lease it to John Meredith skinner, for thirty-one years at £4 p.a., but he paid a fine of £100 and was to spend another £100 in repairs. On July 7, as Harvey had relinquished all claims to the Smithfield messuage his salary was raised to £33 6s. 8d. Most of his predecessors had resided in the precincts, Lopez and Bright among them, but the Governors do not appear to have found that Harvey's non-residence interfered with his attendance at the Hospital.

Nevertheless, difficulties were to arise on this point because of his closer connections with the Royal Court. In the January of 1630 Harvey appeared before the Governors to request that Dr. Smith might act as his deputy while he himself at Charles I's command attended the Duke of Lennox " in his travells beyond the Seas." The Governors replied they would have " further knowledge and satisfaction of the sufficiency of the said Mr. Smith " before they made their decision. Presumably Smith did officiate in Harvey's absence on this occasion for he was later rewarded. However, in April of the follow-

ing year, Dr. Richard Andrewes was granted the reversion of the Physician's office on the death or departure of Dr. Harvey "late sworn Physician in ordinary to His Majesty's Household." Inevitably Harvey's royal appointment interfered with his Hospital work and it is not surprising that certain of the surgeons complained that "whereas Dr. Harvey Physician for the poor of the said Hospital by reason of his attendance on the King's Majesty cannot so constantly be present with the poor as heretofore he hath been, but sometimes doth appoint his deputy . . ." The Surgeons' names are not given but Joseph Fenton, John Woodhall, and Henry Boone were the three surgeons at the time, perhaps James Mullins the lithomist also joined in the complaint. In view of this the Governors ordered on January 19, 1633, that Dr. Andrewes should act as Harvey's deputy and be paid yearly as they thought fit. However, "This order not to prejudice Dr. Harvey in his yearly fee or in any other respect."

Five months later Harvey accompanied King Charles I to Scotland and Dr. Smith came to the Compting House offering his services. He was told by the Treasurer that Dr. Andrewes would act in Harvey's absence, but that if Dr. Smith wished to assist Andrewes in his work "this house would be very well content." To this Smith replied, "There is no need for two."

The whole position was reviewed after Harvey's return, at a meeting on October 15, held to consider a set of rules drawn up by him. The Governors decided "Forasmuch as the poor of this house are increased to a greater number than formerly have been . . . to the greater labour and more necessary attendance of a Physician and being much more also than (is conceived) one Physician may conveniently perform" and as Dr. Harvey now had to attend daily on the King, to appoint Dr. Andrewes as a second Physician at a salary of £33 6s. 8d. Because of Harvey's long service and his royal duties the Governors gave and allowed him "leave and liberty to dispose of himself and time and to visit the poor no oftener than he in his discretion shall think fit." At Harvey's recommendation Dr. Smith was to be paid for his services. He received £10 and was informed that as there were now two Physicians "he do not henceforth trouble himself any more to visit to the poor of this Hospital." Thus the question of deputies was settled. On Andrewe's death, Dr. Clarke was appointed as assistant to Dr. Harvey on August 7, 1634, but the decision was also made then that on the latter's death or departure there should be again only one Physician.

At that meeting of October 15, 1633, when the surgeons were also present, the Governors decided to adopt and enforce the Articles laid before them by Harvey. There are two copies of these among the memoranda in Journal 4, one a fair copy, the other perhaps the first draft submitted for it has deletions and corrections. The first four Articles were allowed to stand ; their purpose was to prevent the Hospital becoming a home for incurables ; only a limited number of such cases were to be admitted, patients certified as "uncurable and scandalous or infectious" were to be discharged or sent to one of the outhouses, which were to admit only people sent from St. Bartholomew's. [The "outhouses," the Lock at Southwark and Kingsland Hospital, were two of the City's medieval leper houses, now administered by St. Bartholomew's.] Patients admitted for a certain length of time were to be discharged when this expired unless it was specially extended. The next rule that a certain number be limited for the doctors' patients was deleted for it ran counter to the charitable purpose of the foundation. The article "That none lurk here for relief only or for slight causes" remained, but that stating that none were to be taken from St. Thomas' Hospital unless "they bring a certificate [that] they have not been there certified cured" was struck out. Those rules which restricted the Surgeons' independence placing them under the supervision of the Physician were adopted by the Governors despite the Surgeons' protest. A man of John Woodhall's experience cannot have welcomed these articles, though they were in keeping with the thought and practice of the times. His fellows on the staff, Fenton and Boone, probably joined in the protests noted in the margin against Article 12. This laid down that every Surgeon should declare his findings and treatments to the Physician so that the latter "may with better judgment order his prescriptions." Article 9 was probably amended because of the Surgeons 'opposition. In the fair copy it reads that "No surgeon or his man do trepan the head, pierce the body, dismember or do any great operation on the body but with the approbation and by the direction of the doctor." Originally they had also been for-

bidden to "let blood, make an issue or cauterise." The Surgeons were not to take in or present patients, nor might they prescribe inward physic without the permission of the Doctor, whose directions they were also to follow in "outward operations for inward causes." In the margin of the rough version against this rule is written "The Surgeons agree to this." There is no comment against the article forbidding their apprentices or servants to perform cures without their oversight. Another rule provides for the attendance of Apothecary, Matron and Sisters when the Physician examines and prescribes, "that they may fully conceive his directions and what is to be done." Matron and Sisters were to report to him or in his absence to the Apothecary, any patients who would not go to him or who refuse to take their medicines despite the penalty of discharge. Finally the Apothecary was not to reveal the Physician's prescriptions except with his permission, to his deputy. Such were the provisions which Harvey thought were necessary for "the good and benefit of the house."

Apart from Dr. Clarke's appointment as assistant to Dr. Harvey in 1634, there are no more references to the latter in the Minutes. However, in a memoranda book there is a prescription dated 1639. It is for the Scurvygrass drink which "shall be henceforth made by the Apothecary with the help and assistance of the matron according to the direction given and agreed upon by Doctor Harvey and Doctor Clarke Physicians, Mr. Edwardes and Mr. Glover (Apothecary)." It began with 36 gallons of 8s. beer and 18 pints of fresh juice from 2 bushels of scurvygrass. The other ingredients include many herbs in use then. "The juice of brooklime 6 pints, of horse radish roots sliced 1lb., of sassafras ½lb., of longe pepper 3oz., grains 3oz., Callamus Aramaticus 2oz., Nuttmegs 1oz., Agremoney, sage, Bettony, hartstongue, saldenella of each six handfuls." These were to be added to the beer and scurvygrass juice to steep for fourteen days. The total cost was calculated to come to 16s.

From the Ledgers we know that Harvey's salary was paid in 1643 for the last time, but his departure was not recorded in the Minutes. Civil War had broken out and Charles I had left London. Harvey had accompanied the King and his two sons to Oxford after the battle of Edgehill in 1642. Perhaps the confusion of the times may account for the lack of any official notice of his resignation. Even on his return to London it does not appear from the Hospital records that Harvey renewed his connections with the Hospital in any way. Nevertheless, his legacy of £30 in 1657 shewed that he had not forgotten St. Bartholomew's where he had served for thirty-four years and where his rules remained in force for many years after his death.

SCHOLARSHIPS & PRIZES
1957

BRACKENBURY SCHOLARSHIP IN MEDICINE
S. Thomas
Prox. Access ..... C. B .S. Wood
BRACKENBURY SCHOLARSHIP IN SURGERY
A. J. Edwards
Prox. Access ..... L. J. Chalstrey
BURROWS PRIZE ..... D. A. Birkett
WALSHAM PRIZE ..... A. J. Edwards
WILLETT MEDAL ..... A. J. Edwards
MATTHEWS DUNCAN PRIZE ... A. J. Edwards
ROXBURGH PRIZE ..... A. M. Hall-Smith
SKYNNER PRIZE ..... A. J. Edwards
HICHENS PRIZE ..... J. Hedley-Whyte
SENIOR SCHOLARSHIP in Anatomy, Physiology and Biochemistry
D. M. Humphreys
Prox. Access ..... J. D. Abell
HERBERT PATERSON MEDAL IN BIOCHEMISTRY
J. J. R. Almeyda
FOSTER PRIZE ..... J. D. Abell
KIRKES SCHOLARSHIP & GOLD MEDAL
Not Awarded
HARVEY PRIZE ..... Not Awarded

Professor K. J. Franklin, F.R.C.P., F.R.S., came to Bart's from Oxford in 1922 as clinical student and part-time demonstrator in physiology (under Professor C. Lovatt Evans). He was a Fellow of Oriel College 1924-47, when he returned to Bart's as Professor of Physiology. In the Great War he served in France and Belgium with the 34th Divisional Artillery.

Dr. E. P. G. Houssemayne duBoulay, D.M.R.D., F.F.R., known as George duBoulay, was educated at Christ's Hospital (which was also K. J. Franklin's school), then King's College and Charing Cross Hospital. He worked at Charing Cross, Derby City Hospital, The Middlesex, St. George's, and served in the R.A.F. and Army. He is now a radiologist on the staff of St. Bartholomew's and The National Hospital for Nervous Diseases, Maida Vale.

He is interested in neuroradiology and 18th Century English furniture and clocks.

VARIATIONS ON A THEME OF HARVEY

by K. J. FRANKLIN *and* G. DU BOULAY

PART 1, *by Professor K. J. Franklin.*

IN CHAPTER ELEVEN of his book on the movement of the heart and blood, William Harvey discussed *inter alia* the effects occurring as a tight ligature, which had been applied to the upper arm for some time, was slackened suddenly into a medium tight ligature such as was used in blood-letting. "You should see," he wrote (Harvey, transl Franklin, 1957), "an immediate coloration and distension of the whole hand, with swelling and varicosity of its veins . . . If at the exact moment that the ligature is loosened one carefully places a finger near it upon the now pulsating artery, one will feel the blood sliding forward, as it were, underneath it and away. Moreover, the actual subject upon whose arm the test is being made, from the very time that the tight ligature is loosened into a medium tight one, will instantly and clearly feel the warm blood entering at each arterial beat now that, so to speak, the obstacle in its way has been removed. And he will have a sensation along the course of the arteries as if something was suddenly distending them and being dispersed throughout the hand; he will also feel his hand itself becoming warm and tense."

I planned a modern extension of the human research described in the passage quoted, but had to defer it *sine die* because overwork on my new translation of *De Motu Cordis*, and other things, led to the occurrence of a cerebral infarct. However, one of the tests employed was a contrast cerebral angiography, performed by Dr. du Boulay, so in a somewhat unexpected way I received some information about sensation in arteries and its apparent passage and speed along and around them.

When asked, therefore, by the editor for a contribution to this Harvey number of the *Journal*, I thought that the extract from my translation, plus the note about my temporary cerebral circulatory upset, plus a statement by Dr. du Boulay about his contrast angiographic experience in this and other cases of arterial abnormality, could well be made into such a contribution.

We pass, then, to

PART 2, *by Dr. G. du Boulay.*

THE LARGE peripheral arteries have numerous afferent end-organs in the adventitia which may be shown in animals to respond when irritant solutions are employed. In man, the sensation which is experienced during the injection of mildly irritant substances is usually one of heat, though occasionally of cold, but it is difficult to know how much of this feeling is due to stimulation of intra-arterial end-organs and how much to stimulation of other afferents near the capillary network which represents the eventual distribution of the artery.

Perfusion experiments on the peripheral arteries in the isolated innervated hind limb show that the nerve endings do not respond to pressure changes within the lumen of the vessel; but more severe alterations in tension of the adventitia do certainly evoke pain in man. I have observed on many occasions that distension of the carotid sheath by peri-arterial injection of normal saline produces pain in the region of the lower molar tooth. This is a poorly localised sensation, possibly modified by the prior infiltration of surrounding tissues with local anaesthetic.

Injection of contrast medium by accident into the wall of the artery and into the tissues around gives rise to aching and burning sensations of a more intense kind in the neck and lower jaw, perhaps because the speed and pressure of such injections is greater than the gentle perfusion with saline.

Having performed some fifteen hundred intra-arterial injections (for the most part of the carotid arteries) I have been struck by the variation in the degree of discomfort which is experienced by different patients.

Occasionally, and particularly when a large intracranial arteriovenous anastomosis causes rapid shunting of contrast medium away from cutaneous vessels and the ophthalmic artery, there may be no appreciation

Fig. 1. Normal internal carotid angiogram. Arterial phase showing anterior, middle and posterior cerebral arteries.

Fig. 3. Abdominal aortogram showing occlusion of the common iliac artery.

Fig. 2. Venous phase of normal carotid angiogram showing superficial and deep veins and sinuses.

Fig. 4. Brachial arteriogram showing narrowing of some of the digital arteries.

that an injection has taken place. Other patients complain of a brief warmth, an intense burning, an electric shock, a blow, bursting or fulness, but for the most part the feeling radiates and is perceived in the cutaneous distribution of the branches of the injected vessel and not in the main trunk, so that the climax of a brachial injection is in the most sensitive skin of the fingers. Injection of the common carotid causes a sensation of heat in the face and scalp, behind the ear, and often in the jaw and neck; the injection of the internal carotid is usually only accompanied by vivid sensory disturbance in the eye and the feeling of heat laid upon the conjunctiva and above the orbit.

The duration of the pain is very short (usually less than one second) and its degree depends partly on the patient's sensitiveness but probably more upon the contrast medium which has been chosen, and upon its concentration.

Upon the instant of filling of the skin capillaries, the area blanches but, immediately following, capillary dilatation occurs and a sharply localised blush is seen by the examiner. It is not usually possible to see the transient oedema which may follow this capillary dilatation; but it may be that the few hazards of carotid and vertebral angiography are related to this phenomenon.

Since Moniz of Lisbon first introduced carotid arteriography in 1927, the injection of radiopaque substances into the arterial blood stream has become commonplace. By serial radiography after the more or less rapid injection of contrast medium, information is obtained about the state of the arteries — about the presence of tumours which may displace the arteries and, if the vessels of the tumour itself are filled, about the pathology of the tumour which has been shown.

The series of roentgenograms will show how, as the arterial shadows disappear, a diffuse haze represents the contrast medium lying in the capillary network. This picture is rapidly followed by the image of circulation into the veins. As yet cinematography using an image-amplifier is only applicable to the larger vessels, as the optical resolving power is not of a high order. Moreover, the amount of radiation to which the patient is exposed is relatively great and the field which may be photographed is small.

Earlier arteriography involved the surgical exposure of the vessel, but percutaneous puncture by means of a needle of extreme sharpness has now been established for a decade and a half as the easier and safer method; it also spares the patient the prolonged discomfort of a healing incision. With the growth in scope of the examination, its name has changed to angiography, so that its title should not exclude the importance of the capillary and venous phases.

Almost all the larger arteries of the body may be punctured directly through the skin and with a little skill and a little practice success in the examination of the aorta and its branches, of the femoral arteries and of the common, internal, and external carotids is certain. Percutaneous puncture of the brachial artery is almost as easy; and with experience the vertebral artery may also be injected with little trouble.

More recently, arterial catheterisation through a percutaneous needle has permitted a greater selectivity in the placing of the contrast substance.

In the ordinary puncture technique the needle is joined by a flexible connection to a syringe — the whole system being filled with saline. After infiltration of the skin and tissues down to and around the artery with local anaesthetic, a puncture is made in the skin with a cutting needle, so that the arterial needle's point is not blunted and the arterial needle does not pick up a core of the skin as it passes through.

As soon as the needle point is through the skin, the syringe is disconnected and capillary attraction is sufficient to keep the saline in needle and connecting piece. Puncture of the artery is then indicated by the rapid escape from the open end of the connection of saline pursued by blood. The saline syringe is reconnected to the tubing, but the needle is not touched or disturbed in any way. The gentle introduction of warm saline into the lumen of the artery is imperceptible to the patient and prevents blood clotting within the system. At the right moment the saline syringe is changed for one containing the contrast medium and after its discharge the slow injection of saline is continued again until the röntgenograms may be viewed, and if necessary a further series obtained.

REFERENCE

Harvey, W. (1957). *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus*, 1628, newly done into English by Kenneth J. Franklin. Oxford. Published for the Royal College of Physicians by Blackwell Scientific Publications Ltd.

HARVEY'S GALEN

by GWENETH WHITTERIDGE

A COPY OF GALEN once owned by William Harvey is now in the possession of the library of the British Museum. It was described by Norman Moore in *The History of the Study of Medicine in the British Isles* (Oxford 1908), Appendix V, pp. 181-6, where, speaking of its interest in general terms, Moore said 'this copy of Galen shows him (Harvey) to us in the act of studying and criticizing the thoughts of another great master of the ancient world.' (The other 'great master' is Aristotle to whose philosophical teachings Harvey acknowledged a profound debt.) Throughout the book there are a number of marginal comments in Harvey's more or less illegible hand. Some of these notes merely stress or call attention to various points made by Galen and these it would be tedious to enumerate; but there are a few which do throw some light on Harvey himself.

This particular edition of Galen is not the one which Harvey used for his serious study of that writer, for it contains none of Galen's major works. It is merely the volume of the *Opuscula Varia* published in London by Dr. Theodore Goulston in 1640[1]. The marginal comments which it contains belong therefore to the last few years of Harvey's life.

Harvey's method of work was typical of the age in which he lived, an age which sought to free itself from the trammels of the classifications and deductive arguments of scholastic learning. While authority was still received and repeated by many, others, like Harvey, had begun to question the value of this authority and to seek to obtain proof by experiment of received opinion. It is, therefore, not surprising to find in the marginal comments in this book, echoes of Harvey's attitude to past experience, authority and experiment. From past experience, he says, no final opinion can be formed, but it is useful in matters of doubt: ex historia non est finale iudicium, tamen in re dubia utilis esse potest (p. 95). When Galen says that past experience is not to be accepted uncritically, Harvey adds that it is not to be accepted at all except in diseases and cases which are doubtful and uncertain: non admitteretur omnino nisi in morbis et casibus dubiis, incertis (p. 92). Again, in matters of doubt and things incapable of proof, Harvey will only believe what is probable. He glosses Galen's remark to the effect that the rational philosopher can pass judgement on the truth or falsity of past events by considering the causes, by saying yes, if the cause is clear, but is it?: quia non habet causa vel incertum et obscurum; habeat necne, tantum probabile (p. 93). In the realm of medicine he will not believe authorities

(1) The following treatises are contained in this volume: *Oratio ad Artes et medicinam hortatoria; Quod optimus medicus idem et philosophus; De optimo docendi genere; De Sectis, ad Tirones;* (These first four treatises have a certain number of underlinings in the text, a few odd words written in the margin, and the initials WH several times appearing where Harvey wished to call his own attention to particular points with which he probably found himself in agreement. There are no marginal comments of any interest.) *De optima Secta, ad Thrasybulum* (pp. 66-143); *De dignoscendis curandisque animi affectibus* (pp. 144-79); *De dignoscendis curandisque animi Erratis* (pp. 180-208); *De substantia naturalium Facultatum* (pp. 209-15); *Quod animi mores sequantur temperamentum corporis* (pp. 216-47).

Gweneth Whitteridge, M.A., D.Phil., F.S.A., educated City of London School for Girls and Lady Margaret Hall, Oxford. Spent a year in Paris learning to read manuscripts. In 1935 became archivist to St. Bartholomew's Hospital and worked with and for Sir D'Arcy Power until the war. During the war taught Old French language and literature in University of Oxford and was civilian lecturer to the Forces. Returned to the Hospital as Archivist in 1947. With her assistant, Miss Stokes, has reorganised the keeping of the Hospital's pre- and post-Reformation archives and has begun the arrangement of this material for the writing of the history of the Hospital.

For the last 18 months she has been working on an almost unknown MS. of Harvey, the De *Motu Locali Animalium*, the contribution of the Royal College of Physicians to the Harvey Tercentenary celebrations.

Is married to David Whitteridge, D.M., F.R.S., Professor of Physiology in the University of Edinburgh.

who disagree with one another in matters of doubt unless they be men of the greatest excellence, whereas in things that are probable he will be inclined to believe a less authoritative pronouncement, provided that he see no reason to gainsay it: in re dubia non credidere authoritatibus ubi invicem adversantur nisi probatissimi viri. In re probabile cuivis probo viro (si nil me contra movet) debeo (p. 95). By his underlining Harvey would seem to have approved of Galen's remark concerning the physiology of Plato that it never transgressed the bounds of verisimilitude or probability, for this he has repeated in the margin: Physiologia Platonis usque ad veresimile (p. 210).

To Galen's remarks that the art of medicine is founded on theories derived from and based upon outward appearances, Harvey has added the comment, Not only, non solum (p. 71); and to a similar remark made elsewhere, he has added a note to the effect that these theories can only be believed if they can be shown to follow of necessity from the said visible signs: nisi demonstratione ex necessariis (p. 69). When Galen says that treatment is merely a matter of applying the remedy known to be effective in the presence of certain symptoms, Harvey asks how can this be found out except by experiment: quomodo? nisi experimentia (p. 10). Yet he protests against Galen's statement that history should be judged by experiment, pointing out that many treatments, and some of these the very best, are empirically accepted and are incapable of rational proof: plurima vero medicamenta eaque optima in historiis qualibet ratione probare impossibile, similiter morbi (p. 93).

Burning curiosity, Harvey remarks elsewhere, makes the physician: Empyria ergo medicum ratio curiosa facit (p. 102). It was certainly a quality of Harvey's own that not only led him to the discovery of the circulation of the blood, but underlies all the minute observations of people and animals that characterize his writings. There is only one note relating to his personal observations in this copy of Galen. He underlines Galen's statement to the effect that in no two sick people can events follow an identical pattern and remarks that no one person is sick in the same way as another of the same disease, not even when suffering from plague, snake-bite or the pox: sic enim neminem eodem morbo laborare, contendere, non in pestilentia nec ex ictu viperae, lue venerea, etc. (p. 88).

Of Harvey's religious view and opinions nothing is really known, for there is no direct reference to them in any of his extant works. He was indeed the physician and a great favourite of the Lord High Marshal of England, the Catholic Earl of Arundel, who, on May 6, 1636, wrote from Cologne to Mr. Secretary Windebank (a future Catholic convert) saying: "I have been this evening at the Jesuits' fair new church and college. I found in the college little Dr. Hervey, who means to convert them.' Had Harvey not been well known to both men as a Protestant, the jest would have been pointless. As a friend of King Charles, it is quite possible that he was in sympathy with the High-Church party of the Church of England. John Aubrey says of him that he was far from bigotry and describes him as "a pious good man." A few remarks in this copy of Galen seem to bear out this contention. Among the notes scribbled down on the end fly-leaf, the one which is most easily legible is the remark that a man should give heed to his own sins and errors: necesse propria peccata et errores notare. It is true that the remark refers back to a passage in Galen's text, but it is interesting that Harvey thought it worth while to single it out for comment. Furthermore, when Galen advises that a man should again and again ask for help if some disquietude of mind trouble him, Harvey has added in the margin that this is the use of a confessor: usus confessoris (p. 149). A few pages further on he has underlined Galen's statement that the punishment of concupiscence is the impossibility of obtaining any of the things desired.

The chief errors which a man can make Harvey believed to spring from credulity and arrogant temerity: prima erratorum occasio credulitas, temeritas (p. 182). His underlings show him to have been interested in Galen's statement that the first and greatest of all errors is to make a rash pronouncement out of self-love, or of ostentation of knowledge, or of arrogance or ambition, and he comments on the passage to the effect that the first error is not to be able to distinguish between these things: primum erratum, differentias non discernere (p. 183). But when, a little further on in this treatise, Galen claims that he himself can do certain things and can point the way to truth, Harvey has several times written in the margin the single word, Arrogant.

WRITINGS ON WILLIAM HARVEY BY BART'S MEN

by JOHN L. THORNTON

SINCE THE DEATH of William Harvey three hundred years ago there has been an enormous amount of literature devoted to his life and to certain aspects of his work, in addition to accounts given in general histories of medicine, biology and physiology. The "Select Bibliography of Writings on William Harvey (1578-1657)" published in *Current Work in the History of Medicine* (9, 1956, pp. 57-62 ; 10, 1956, p. 131), gives some idea of the extent of this material, and is obviously selective. A list of writings by and about Harvey available in the Medical College Library was compiled some time ago, from which it is apparent that Bart's men have by no means neglected their distinguished seventeenth century Physician. In 1846, Sir James Paget published extracts from the Hospital Journals relating to Harvey, and since then Sir D'Arcy Power, Sir Wilmot Herringham, and Sir Geoffrey Keynes in particular have contributed in no mean manner to our knowledge of Harvey. Several Bart's men have delivered Harveian Orations, and it is hoped that the following annotated list will remind us that Harvey has not been ignored in his own Hospital. The list also includes articles that have appeared in *St. Bartholomew's Hospital Journal* and *St. Bartholomew's Hospital Reports* contributed by persons other than Bart's men.

B[ACKHOUSE], IAN H. Where is William Harvey to go? (Editorial). *St. Bart's Hosp. J.*, 56, 1952, pp. 413-5.
A summary of the controversy regarding the Harvey Chapel and sarcophagus at Hempstead, then in a state of disrepair. It was suggested that Harvey's remains should be removed to St. Bartholomew-the-Great, and several letters regarding this were subsequently published in the *Journal*.

FRANKLIN, KENNETH JAMES. A survey of the growth of knowledge about certain parts of the foetal cardio-vascular apparatus, and about the foetal circulation, in man and some other mammals. Part 1: Galen to Harvey. *Ann.Sci.*, 5, 1941-2, pp. 57-89.
See also the same author's *A short history of physiology*, 2nd ed. (1949), Chapter VIII ; William Harvey.
K. J. Franklin has prepared a new translation of *De motu cordis* to be published this year for the Royal College of Physicians.

————. William Harvey — a speculative note. *Gesnerus*, 5, 1948, pp. 70-74.
Harvey spent much time contemplating in caves in the grounds of Coombe Lodge, and the surroundings in which he thought out his writings are discussed.

HARVEY, WILLIAM. The anatomy of Thomas Parr. *St. Bart's Hosp.Rep.*, 72, 1939, pp. 17-22.
Harvey performed a post-mortem on "Old Parr," who died in 1635 at the reputed age of 152 years. This is a translation by Arnold Muirhead of Harvey's notes, with an introduction by Sir Geoffrey Keynes.

HERRINGHAM, *Sir* WILMOT PARKER. The life and times of Dr. William Harvey. *Ann. med. Hist.*, N.S.4, 1932, pp. 109-125, 249-272, 347-363, 491-502, 575-589.
A fully-documented account, evaluating Harvey's work in relation to its historical background. This is a greatly enlarged version of Herringham's Harveian Oration for 1929.

————. William Harvey at St. Bartholomew's. A speech delivered at the luncheon given to the Delegates to the

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John Leonard Thornton

Born 1913 at Edgware, Middlesex. He trained at University College, London, from 1929 to 1934 and attended the School of Librarianship. He then became a member of the staff of the Wellcome Historical Medical Library in 1934. Mr. Thornton came to Bart's in January, 1938, and was appointed Librarian to the Medical College the following year. During the war he served four years in the Royal Corps of Signals.

He is the author of 'John Abernethy,' and several other books on librarianship and the history of medicine and science.

Harvey Tercentenary by the Treasurer and Almoners of the Hospital. *St. Bart's Hosp.J.*, 35, 1927-8, pp. 133-6.
A factual account, with a transcript of Harvey's Charge detailing the duties of his office as Physician.

HUNTER, RICHARD A., and MACALPINE, IDA. William Harvey. Two medical anecdotes, the one related by Sir Kenelm Digby, the other by the Honourable Robert Boyle. *St. Bart's Hosp. J.*, 60, 1956, pp. 200-206.
Indicative of Harvey's interest in neurology and psychiatry.

KEYNES, *Sir* GEOFFREY LANGDON. *A bibliography of the writings of William Harvey.* [*etc.*], Cambridge, 1928; 2nd ed., 1953.
The standard list of Harvey's writings, with full bibliographical descriptions, annotations, illustrations, locations of copies, [*etc.*]. In 1928 Sir Geoffrey also edited for the Nonesuch Press the beautifully-produced translation of Harvey's *Anatomical exercises*, [*etc.*], (1928).

————. Harvey and his books. (Harveian Lecture.) *St. Bart's Hosp.J.*, 57, 1953, pp. 177-182, 212-216.
Mainly concerned with Harvey's writings, but also mentioning the books he possessed. An erudite appreciation and evaluation of Harvey's work.

————. *The personality of William Harvey.* [*etc.*], Cambridge, 1949.
The Linacre Lecture for 1949, containing several portraits.

————. The portraits of William Harvey. *Brit.med.J.*, 1950, II, p. 43.

————. *The portraiture of William Harvey.* [*etc.*], 1949.
The Thomas Vicary Lecture for 1948, this contains a re-evaluation of the portraits of Harvey, with reproductions of most of the items discussed.

MOORE, *Sir* NORMAN. Harvey. *Proc.roy.Soc. Med.*, 9, ii, 1916, Sect.Hist.Med., pp. 9-20. Mentions some of the sources consulted by Harvey, with notes on Harvey's manuscripts and letters. Moore also wrote the life of Harvey in the *Dictionary of National Biography*, and delivered the Harveian Oration in 1901.

MUNK, WILLIAM. Notae Harveianae. *St. Bart's Hosp.Rep.*, 23, 1887, pp. 1-12.

PAGET, *Sir* JAMES. *Records of Harvey in extracts from the Journals of the Royal Hospital of St. Bartholomew.* ... With *notes*, 1846. Reprinted in *St. Bart's Hosp. Rep.*, 22, 1886, pp. 1-37.
First published while Paget was Warden of the College, this provides literal transcripts of the entries relating to Harvey in the Journals of the Hospital.

POWER, *Sir* D'ARCY. Dr. William Harvey and St. Bartholomew's Hospital. *St. Bart's Hosp.Rep.*, 57, 1924, pp. 96-107; 61, 1928, pp. 1-11.
Includes Harvey's Charge and Regulations, and records all the meagre details available of Harvey's connection with the Hospital.

————. Dr. William Harvey as a man and as an art connoisseur. [N.D.] Reprinted from *Congrès International d'Histoire de la Médécine.*

————. A memorial group of the Harvey family [1549-1661]. *Ann.med. Hist.*, N.S.1, 1929, pp. 241-2.
Description and photograph of the Harvey family group, then at Rolls Park, Chigwell, Essex.

————. *Portraits of Dr. William Harvey*, 1913.
A large quarto published for the Historical Section of the Royal Society of Medicine, containing numerous reproductions of portraits, some of which are now believed not to be authentic. See book on same subject by Sir Geoffrey Keynes.

————. A purchase of land by the family of Dr. William Harvey. *Ann.med. Hist.*, 3rd Ser., 2, 1940, pp. 308-311.
Description of the original release of the property, Clifton Mabank, Wyke Manor near Sherborne and part of Bradford, Dorset. This document is now in the Royal College of Physicians Library.

————. A revised chapter in the life of Dr. William Harvey, 1636. *Proc.roy. Soc.Med.*, 10, ii, 1917, Sect.Hist.Med. pp. 33-59.
Contains information on Harvey's travels in Europe with the Earl of Arundel, *etc.*, gleaned from an account of the travels, from Harvey's letters to Lord Feilding, afterwards Earl of Denbigh, and from a biography of the latter.

————. *William Harvey*, 1897. (Masters of Medicine Series.)

A concise life, and still the best general source of information on Harvey, who deserves a modern, full-scale biography.

ROLLESTON, *Sir* HUMPHRY DAVY. Harvey's predecessors and contemporaries, *Ann. med.Hist.*, 10, 1928, pp. 323-337.

————. The reception of Harvey's doctrine of the circulation of the blood in England as exhibited in the writings of two contemporaries. In, *Essays on the history of medicine presented to Karl Sudhoff. . . . Edited by Charles Singer and Henry E. Sigerist*, London, Zürich, 1924, pp. 247-254.
The writers referred to are Thomas Winston (1575-1655) and Henry Power (1623-1668), there being lengthy quotations from the latter.

THORNTON, JOHN L. The writings of Harvey [in St. Bartholomew's Hospital Medical College Library.] *St. Bart's Hosp.J.*, 51, 1947-8, pp. 61-2.

WENDELL-SMITH, C. P. William Harvey, man-midwife. *St. Bart's Hosp.J.*, 53, 1949, pp. 212-214.
An appreciation of Harvey's work in the field of obstetrics, which is so often overlooked.

HARVEIAN ORATIONS

The Harveian Oration was endowed by William Harvey by a gift to the College of Physicians, and the first oration was delivered in 1656, the year before his death. The orations were first delivered and printed in English in 1865. It is a strange coincidence that up to 1866 apparently only two Bart's men had delivered the oration, John Latham in 1794, and his son Peter Mere Latham in 1839. Much interesting information on the subject is contained in: W. J. Bishop and F. N. L. Poynter. The Harveian Orations, 1656--1947: a study in tradition. *Brit.med.J.*, 1947 II. pp. 622-3.

In the following list, where no specific title is given, it was published as "The Harveian Oration."

1794: John Latham. (Published by Longman).

1839: Peter Mere Latham. (Published by Spottiswoode).

1866: Sir George Edward Paget. (Published by Bell.)

1872: Arthur Farre. The analysis of Harvey's exercises on generation. *Brit.med.J.*, 1872 II, pp. 1-4, 29-32.

1873: George Rolleston: *Brit.med.J.*, 1873 II, pp. 29-32.

1874: Charles West. *Brit.med.J.*, 1874 II, pp. 1-8.

1883: Samuel Osborne Habershon. The advancement of science by experimental research, *Brit.med.J.*, 1883 I, pp. 1265-70.

1888: Peter Wallwork Latham. On blood changes in disease. *Brit.med.J.*, 1888 II, pp. 859-64.

1890: James Andrew. Conditions of the pulmonary circulation. *Brit.med.J.*, 1890 II, pp. 939-43.

1894: Sir Thomas Lauder Brunton. Modern developments of Harvey's work. *Brit.med.J.*, 1894 II, pp. 853-8.

1895: Sir William Selby Church. Harvey and the rise of physiology in England. *Brit.med.J.*, 1895 II, pp. 1013-8.

1898: Sir Dyce Duckworth. The influence of character and right judgement in medicine. *Brit.med.J.*, 1898 II, pp. 1209-1215.

1901: Sir Norman Moore. *Brit.med.J.*, 1901 II, pp. 1217-1223.

1908: Joseph Arderne Ormerod. On heredity in relation to disease. *Lancet*, 1908 II, pp. 1199-1203.

1920: Sir Frederick William Andrewes. The birth and growth of science in medicine. *Brit.med.J.*, 1920 II, pp. 615-9.

1922: Arnold Chaplin. On medicine in the century before Harvey. *Brit.med.J.*, 1922 II, pp. 707-712.

1928: Sir Humphry Davy Rolleston. Cardiovascular diseases since Harvey's discovery. *Brit.med.J.*, 1928 II, pp. 683-9.

1929: Sir Wilmot Parker Herringham. Circumstances in the life and times of William Harvey. *Lancet*, 1929 II, pp. 911-17.

1935: Sir Henry Hallett Dale. On some epochs in medical research. *Brit.med.J.*, 1935, II, pp. 771-7.

1936: Sir Walter Langdon-Brown. The background to Harvey. *Brit.med.J.*, 1936 II, pp. 793-9.

1953: George Graham. The value of physiology in medicine. *Brit.med.J.*, 1954 I, pp. 225-33.

HARVEY

De Motu Cordis Et Sanguinis In Animalibus

The famous Doctor Harvey was physician here at Bart's ;
He studied the biology of blood vessels and hearts ;
He carried out experiments, and this is what he found—
The blood of men and animals goes coursing round and round.

The gallant Doctor Harvey went a-riding to the Wars ;
He mobilised at Oxford, and embraced its first ' Lost Cause.'
Amid the civil conflict he divined this truth profound
That the blood of men and animals goes coursing round and round.

The loyal Doctor Harvey went campaigning with his King ;
He witnessed Rupert's Cavaliers roll up the Roundheads' wing.
His conviction did not weaken on Edgehill's battle ground
That the blood of men and animals goes coursing round and round.

Civilian Doctor Harvey returned to Bart's again :
He continued his experiments—the facts they shewed were plain.
In his lectures to his students he would patiently expound
That the blood of men and animals goes coursing round and round.

Persistent Doctor Harvey, three hundred years ago,
Eventually published his " EXERCITATIO
DE MOTU SANGUINIS," in which he firmly stood his ground
That the blood of men and animals goes coursing round and round.

He traced the circulation ; beginning with the vein
To auricle and ventricle, to lungs and heart again,
To the tissues, and once more by veins returning heart-ward bound,
The blood of men and animals goes coursing round and round.

The theory was challenged, and controversy raged :
In fact a second civil war was very nearly waged.
Once more in wordy warfare men felt their pulses bound—
The blood of men and animals goes coursing round and round.

But Truth and Doctor Harvey at length prevailed, and won !
His Alma Mater celebrates to-day her greatest son.
In proud acclaim of him, whose fame three centuries have crowned,
The blood of men, today as then, goes racing round and round.

R.B.B.P.

HARVEY AND EMBRYOLOGY

by C. P. WENDELL-SMITH

"None age so perfectly that subtle change
With time or custom seems not new nor strange;
What's once believed is now denied and what
Was honoured once now suffers in exchange."[1]

IT WAS Geronimo Fabricio da Aquapendente (1533-1619) who stimulated the interest of William Harvey in embryology. Fabricius was mentor to Harvey in the years between 1598 and 1602 when he studied at the University of Padua. Incidentally, this dates our first glimpse of Harvey studying the chick, "upon one occasion, in the spring, by way of helping out Fabricius."[2]

Teaching at Padua, in the early seventeenth century was dominated by traditional doctrines, and Fabricius did little to change this. Indeed, his pupil suggested that he held to the old opinions pertinaciously "from respect to the ancients."[3]

Let us examine the history of those aspects of embryology with which Harvey concerned himself.

The basic method of investigation was described in the Hippocratic collection. "Take twenty or more eggs and let them be incubated by two or more hens. Then each day from the second to that of hatching remove an egg, break it, and examine it. You will find exactly as I say, for the nature of the bird can be likened to that of man."[4]

Aristotle followed this technique and presented an account of chick embryogeny on which all later work was based. On the basis of naked eye observations he concluded that the heart was the first formed and most important organ. He supposed the embryo to form from menstrual clot influenced by the male sperma, thus the male element gave form and the female substance.

On this same question Galen, following Empedocles, believed that the foetus was formed from male and female semen, sex being determined by the relative amounts contributed by each parent. He taught that the liver was the first organ and believed that observations on the internal anatomy of animals could be applied to man without modification. This was accepted without question until after the Vesalian reform.

A Vesalian student, Fallopius, was one of those who demonstrated that the appearance of homologous organs varies in different species. On this and other points Galenical authority was giving place to accurate observation.

The Works of Fabricius, who was a pupil of Fallopius, have been edited by Adelmann.[5] He suggested that Fabricius should be regarded rather as an observer than as an interpreter. He certainly made many accurate observations and dissected the embryos of man, rabbit, guinea-pig, mouse, dog, cat, sheep, pig, horse, ox, goat, deer ,dogfish and viper.[6] His pupil, Harvey, was able to supply the correct interpretation of many of these observations:

"Fabricius observed the point of origin of the chick, the spot or cicatricula, namely, which presents itself upon the tunica propria of the yelk; but he regarded it as a cicatrice or scar left on the place where the peduncle had been attached; he viewed it as a blemish in the egg, not as any important part."[7] He gave a good account of the reproductive tract of the hen, including the first description of the Bursa Fabricii: "The foramen, into which Fabricius believes the cock to inject his fluid, is discovered between the orifice of the vulva and the rump. I, however, deny any such use to this foramen; for in young chickens it is scarcely to be seen, and in adults it is present indifferently both in males and females. It is obvious, therefore, that it is both an extremely small and obscure orifice, and can have no such important function to perform: it will scarcely admit a fine needle or a bristle, and it ends in a blind

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Dr. C. P. Wendell-Smith, M.B., B.S., D.Obs., was Manager of the Journal from 1948 to 1950. He qualified in 1951 and is now in exile across the water in the Anatomy Department at Guy's.

cavity ; neither have I ever been able to discover any spermatic fluid within it, although Fabricius asserts that this fluid is stored up there even for a whole year, and that all the eggs contained in the ovary may be thence fecundated, as it is afterwards stated."[9]

Finally, Fabricius was the first to illustrate a systematic study of chick embryogeny, to describe human decidua, and to classify the forms of placenta. This, then, was the master. What more of his pupil?

We find in Harvey's writings the beginnings of the break with dogma. He made use of experiments, of comparative observations and of the quantitative method, to test theories and demonstrate facts. "And though much has already been made out by the learned men of former times, I have still thought that much more remained behind, hidden by the dusky night of nature, uninterrogated ; so that I have oftentimes wondered and even laughed at those who have fancied that everything had been so consummately and absolutely investigated by an Aristotle or a Galen, or some other mighty name, that nothing could by possibility be added to their knowledge."[9]

According to the Aristotelian and Galenical doctrines after fertile intercourse the uterus would contain a coagulum of sperma and menstrual blood or of mixed semen. Harvey put the matter to the test in fowls and deer. The animals were segregrated after coitus and the uterus opened at varying intervals, some being allowed to go to term. He concluded "that neither does any such imaginery mixture of seminal fluids take place in any animal, nor that immediately upon intercourse, even of a fruitful kind, is there anything in the shape of semen or blood, or of the rudiments of an embryo present or demonstrable in the cavity of the uterus."[10] This was a reasonable conclusion on the evidence available without a microscope.

Before the time of Harvey no one had questioned the spontaneous generation of plants and animals from mud and putrefying matter. Harvey wrote, "all animals whatsoever may be said in a certain sense to spring from ova, and in another certain sense from seminal fluid ; and they are entitled oviparous, viviparous or vermiparous, rather in respect of their mode of bringing forth than of their first formation."[11] Further "many animals, especially insects, arise and are propagated from elements and seeds so small as to be invisible, (like atoms flying in the air) scattered and dispersed here and there by the winds ; and yet these animals are supposed to have arisen spontaneously, or from decomposition because their ova are nowhere to be found."[12]

However, in other passages he uses language that seems to be consistent with a belief in spontaneous generation. This may be a false impression due to the difficulty of interpreting seventeenth century Latin. Thus the interpretation of his contemporaries is important. Francesco Redi (1625-98) obviously had no doubts about Harvey's meaning, for he wrote: "That greatest philosopher of our time, William Harvey, held firmly to the opinion that all living things originated from seed, as from an egg."[13] Redi then confirmed Harvey's opinion experimentally by the observation of meat allowed to putrefy in gauze-covered receptacles.

It was Redi who introduced the dictum *omne vivum ex ovo* often credited to Harvey. The words *ex ovo omnia* are found on the frontispiece of Harvey's *De Generatione Animalium* (1651), but they are not found in the text. Indeed, Bayon (1947) thinks it likely that the frontispiece was chosen by George Ent, for Harvey gave him the manuscript with full authority to deal with it as he pleased.

In this book the first sixty-two exercises are devoted to the study of the fowl and egg. By the meticulous examination of eggs at different stages, Harvey was able to throw light on many points which had been disputed for centuries.

"In so far as we can conjecture from the course and distribution of the veins, the embryo from the comencement is nourished by the colliquament; upon this blood vessels are first distributed, and then they spread over the membrane of the thinner albumen, next over the thicker albumen, and finally over the vitellus. The thicker albumen serves for nutriment after the thinner; the vitellus is drawn upon last of all[14] . . . an egg is a body, the fluids of which serve both for the matter and the nourishment of the parts of the foetus."[15] The age-old controversy as to which part of the egg was nutritive and which was formative was quashed.

On the subject of pre-formation he said: "Now it appears clear from my history that the generation of the chick from the egg is the result of epigenesis, rather than the metamorphosis, and that all its parts are not

fashioned simultaneously, but emerge in their due succession and order; it appears, too, that its form proceeds simultaneously with its growth, and its growth with its form; also that the generation of some parts supervenes on others previously existing, from which they become distinct; lastly, that its origin, growth, and consummation, are brought about by the method of nutrition; and that at length the foetus is thus produced."[16]

The remainder of this book is devoted to studies on mammals, and here Harvey was man's estate, to take the diversion of hunting almost every week, both for the sake of finding relaxation from graver cares, and for his health; the chase was principally the buck and doe, and no prince in the world had greater herds of deer, either wandering in freedom through the wilds and forests, or kept in parks and chases for this purpose. The game during the three summer months was buck, then fat and in season; and in the autumn and winter, for the same length of time, the doe. This gave me an opportunity of dissecting numbers of these animals

EXERCITATIONES
DE
Generatione Animalium.

Quibus accedunt quædam
De Partu: de Membranis ac humoribus Uteri:
& de Conceptione.

AUTORE
GULIELMO HARVEO
Anglo, in Collegio Medicorum *Londinensium* Anatomes & Chirurgiæ Professore.

LONDINI,
Typis Du-Gardianis; impensis *Octaviani Pulleyn* in Cœmeterio *Paulino*.
M. DC. LI.

Title-page and frontis piece of the first edition of William Harvey's De Generatione.

in the van of fashion. Apart from an apocryphal story that Cleopatra dissected slaves at known intervals from the time of conception, his are the first recorded observations of mammalian embryogeny. During the following century, however, mammals were popular subjects with embryologists, and the chick was relatively neglected.

"It was customary with his Serene Majesty, King Charles, after he had come to almost every day during the whole of the season when they were rutting, taking the male, and falling with young; I had occasion, so often as I desired it, to examine and study all the parts, particularly those dedicated to the offices of generation."[17] Opportune as this was, it was also unfortunate, because among the *Cervidae* there is a considerable time-lag between fertilization and the appearance of

a macroscopic conceptus. When Harvey put the classical theories of conception to the test and performed segregation experiments, this factor misled him. He was led to fruitless speculation on problems which could only be solved by finer methods than were then available.

Harvey on the circulation is on firmer ground. *De Motu Cordis* (1628) is scattered with embryological references, and both books contain accounts of the foetal circulation which incorporate clinical observations. "Besides, in a tedious labour, we learn whether the infant is alive or not by the pulsation of the umbilical arteries; and it is certain that these arteries receive their impulse from the heart of the foetus and not of the mother, for the rhythm of the two differs: this can be easily ascertained if one hand is applied to the wrist of the mother and the other to the umbilical cord. Nay, in the Caesarean section, when the embryo is still enveloped in the chorion, I have often found the umblical arteries pulsating, and the foetus lively, even when the mother was dead and her limbs stiffened. It is not, therefore, true that the 'spirits' pass from the mother to the foetus through the arteries; nor is it more so that the umbilical or foetal vessels anastomose with those of the uterus. The foetus has a proper life of its own, and possesses pulsating arteries filled with blood and 'spirits,' long before the 'conception', in which it is formed and dwells, is attached to the uterus; just as it is with the chick in the egg."[18] The idea of an independent embryo with active organs was quite contrary to Fabricius' teaching.

Harvey's critics through the ages have said that he did not break sufficiently with tradition and that too much of his work is devoted to unprofitable speculation. Be this as it may, he was the most progressive biologist of his day and has proved prophetic in many respects. Certainly he achieved his aim, which was "not merely that posterity may there perceive the sure and obvious truth, but farther, and especially, that by exhibiting the method of investigation which I have followed, I may propose to the studious a new and, unless I mistake, a safer way to the attainment of knowledge."[19]

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SO TO SPEAK . . . .

Mr. F - - - - r (muttering): "Well, well, we'll have to see if your husband is homozygous."

Patient: "Oh no, Doctor, my Jim's never done anything *unnatural*."

DR. MAY'S MONSTER

A chapter in the history of the circulation of the blood

by RICHARD A. HUNTER *and* IDA MACALPINE

"IT WAS my fortun to be in a late communication where a Gentleman spoke of a hideous thing that happen'd in High-*Holborn*," wrote a horror-stricken citizen of London to Sir Kenelm Digby in May 1640, "how one *John Pennant* a young man of 21, being dissected after his death, ther was a kind of Serpent with divers tails found in the left Ventricle of his heart . . . This Serpent was it seems three years ingendring . . . God preserve us from public calamities; for Serpentin Monsters have been often ill-favoured presages . . . I remember in the Roman story . . . there follow'd bloudy Civil Wars" (Howell, 1655). Digby's correspondent was referring to a case history and postmortem findings published in a small book towards the end of 1639, which quickly aroused a storm of conjecture and mystification all over Europe: within ten years of its appearance it had been quoted in medical texts published as far afield as Rome (Servius, 1642), Lyons (Zacutus, 1642), Frankfurt (Severinus, 1643), Paris and Leyden (Riolan, 1648; 1649).

For more than a century consternation and speculation about the precise nature of the "serpent in the heart" continued in scientific circles, while the story was handed down from one medical author to the next. Wanley (1678) gave it pride of place in his encyclopaedic book of *Wonders of the Little World* in the section on "the Heart; and in what manner it hath been found in some Bodies." By 1700 the serpent was so well established that Nicholas Andry — soon to become Professor of Medicine in the Royal College of France — raised "Cardiack Worms" to a separate species in his *Account of the Breeding of Worms in Human Bodies* and described the symptomatology of patients so affected: "*Cardiack* or Heart-worms, occasion Tremblings, Swoonings, and the *Lunatick* disease, falsely imputed to the Moon." In treatment he wrote "all other Remedies except Garlick signified nothing," and illustrated the efficacy of this remedy by retailing the story of such a worm taken from the heart "and put alive upon a Table in the midst of a Circle drawn with Juice of Garlick; the *Worm* began to contract itself on all sides, and getting still as far as it could from the Circumference of the Circle, at length, compelled by the smell of the Garlick, retired and took up the very Centre, where it died through the strength of the Smell." So firmly was the "Cardiack Worm" still entrenched in the middle of the 18th century that it remained for Morgagni (1761) in his classic *De Sedibus et Causis Morborum* to give it the *coup de grâce*.

It would have been surprising had such a remarkable pathological finding in the heart not come to the notice of William Harvey. For instance, Marcus Aurelius Severinus, the eminent professor of anatomy and surgery at the University of Naples, was so troubled by it that he wrote post-haste to a friend in England asking him to obtain Harvey's opinion on its nature (Severinus, 1643). Harvey's answer may be gathered from further letters of Severinus recently discovered and published (Trent, 1944): they show that he had recognized the nature of the serpent more than a hundred and twenty years before Morgagni.

The original of all these stories was *A most certaine and true Relation of a strange Monster or Serpent found in the Heart of John Pennant, Gentleman, of the age of* 21 *yeares* (Fig. 1), written by an obscure physician, Edward May. He had delayed publication for more than two years and perhaps chose the end of 1639 as a suitable moment to spring into prominence with this remarkable account: England was passing through troublous times of imminent civil war, and superstition had it that the appearance of snakes in unexpected places was a fateful augury —

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a point appreciated by Digby's friend Howell. More pertinent today is the fact that May thought his findings contradicted Harvey's eleven-years-old circulation of the blood, and therefore included a diatribe against it. For how, he argued, could the heart's systole

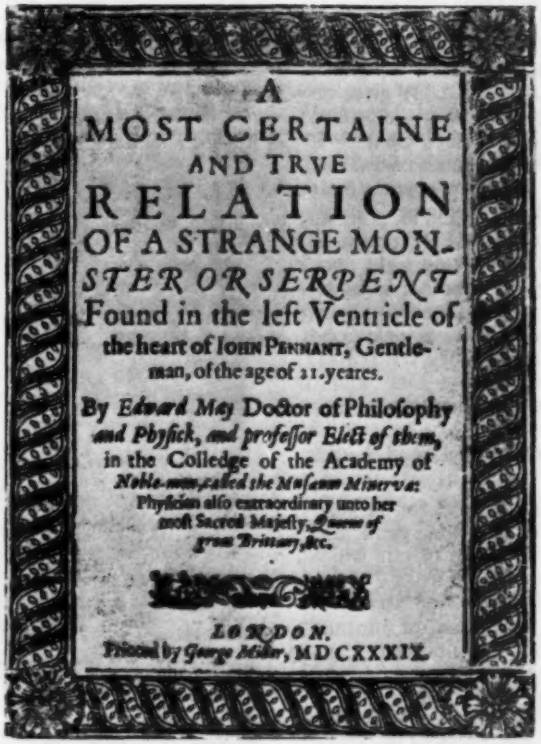
A
MOST CERTAINE
AND TRVE
RELATION
OF A STRANGE MON-
STER OR SERPENT
Found in the left Ventricle of
the heart of IOHN PENNANT, Gentle-
man, of the age of 21. yeares.
By Edward May Doctor of Philosophy
and Physick, and professor Elect of them,
in the Colledge of the Academy of
Noble-men, called the Musæum Minervæ:
Physician also extraordinary unto her
most Sacred Majesty, Queene of
great Britany, &c.
LONDON.
Printed by George Miller, MDCXXXIX.

Figure 1. *Title page of Edward May's book.*

account for the pulse, and how indeed could the blood circulate at all, if as in this patient, it had been confined for three years in a heart blocked by a growing serpent?

Thus May's book has historical importance as the first written in English by an Englishman to challenge Harvey's (1628) *De Motu Cordis*, and the third all told following those of Primrose (1630) and Parisanus (1635). Although overlooked by historians of the circulation such as Willis (1878) and Bayon (1938-39), May's attack on Harvey did not escape the notice of his contemporaries. Riolan (1648), Harvey's most eminent adversary and the only one honoured with a printed reply in which Harvey (1649) eulogized him as "the prince and leader of all the anatomists of the present age," quoted May's case as a clinical example of obstructed circulation which excluded the possibility of a circulation of the blood as visualised by Harvey. But Trent (1944) in his commentary on Severinus's correspondence did not identify May's book, and therefore missed the significance of the serpent as a product of the early opposition to Harvey.

Indeed, May's name failed to register in any standard general, medical or scientific biographical compilation. His book remains only as a rare bibliophile's curio, while its significance as a chapter in the early history of the circulation of the blood was soon for-

gotten, although the story of "the serpent in the heart of an Englishman" lived on. Therefore it is perhaps only fair and charitable to remember him this month in which is celebrated the tercentenary of the death of William Harvey.

Edward May

May's only other known publication, a small work of 78 pages entitled *Epigrams Divine and Morall* (London, 1633), gives no personal information, its author describing himself simply as "Edw. May, Gent." It consists of short verses, sometimes coarse and often laboured, some of which contain hints that he was then studying medicine. Thus:

To Cotta [? John Cotta, M.D., physician and author]
Cot knows his wife's a whore, & saies 'tis right,
One lampe may giue a score of men good light.

On a surgeon
A Skilfull Surgeon does these three command,
A Lions heart, Hawkes eye, and Ladies hand.

By 1634 he was in practice, for he later recalled "being sent for to a yong gentleman . . . who was sick of that kind of pox which our Country people call the Flocks" (May, 1639). The *State Papers, Domestic Series*, for August 1639, contain an account of information May laid before Archbishop Laud against Captain Napier (perhaps Archibald Napier, for whom see *The Dictionary of National Biography*). May happened to meet him while on a professional visit at the house of a patient aptly called Mrs. Cromwell: in the course of casual discussion of political events Napier allowed himself to be drawn into seditious utterances against king and clergy. The documents record the depositions of witnesses, headed by May, whose motive in denouncing Napier can at best be construed as patriotism, at worst as the desire to curry favour in high places.

More information about May is revealed by his description on the title page of *A most certaine and true Relation* (Fig. 1). Surprisingly he was not a member of the College of Physicians, although this was a prerequisite for legitimate medical practitioners in London. His doctorate of "Philosophy and Physick" was a style of Continental graduation common at that time, although it has not been possible to trace his name in published university lists. The office of "professor Elect of them, in the Colledge of the Academy of Noble-men, called the Musaeum Minervae" was not fanciful: in fact Minerva's Museum was the name given to a scientific foundation which was the direct forerunner of the Royal Society of London (Weld, 1848). Its function was to instruct the young nobility in the liberal arts and sciences. In the original licence granted on June 26, 1635, by Charles I, May headed the list

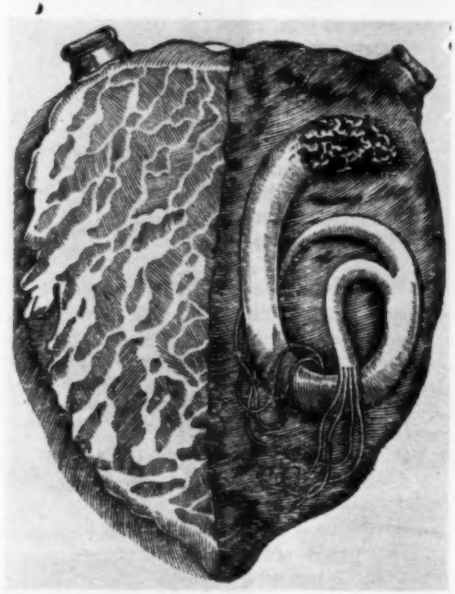

Figure 2. How the coiled serpent was found in the heart.

of six professors as "The Doctour of Philosophie and Physick" whose duties were to "reade and professe Physiology, Anatomy, or any other parts of Physick." The other professors elect were of music (Thomas Hunt, the only one to achieve an entry in *The Dictionary of National Biography*); astronomy; geometry; languages; and fencing (Sanderson, 1732).

A printed version of its constitution in 1636 defined May's duties further in terms which suggest that its governors had imbibed some of Harvey's scientific spirit: "*Item*, the Professour of *Philosophie and Physick* and his Assistant or Assistants shall from time to

time according to their abilities and opportunities make experiments of naturall things, chiefly for medicinall use, and what they finde certain shall be recorded, and what they finde otherwise shall in a book by it self be noted, how and in what manner experiment was made, and how it failed, that men may not afterwards spend their pretious time and meanes in vain, and that the licentious abuses of *Impostors* hereafter may be detected."

A building was prepared in Covent Garden and there " at the Colledge of the Museum Minervae " on February 27, 1635/6 a masque entitled " Corona Minervae " was performed before "Prince Charles His Highnesse, The Duke of Yorke his Brother, and the Lady Mary his Sister." But somehow the project came to grief, and three years later May was still only "professor Elect."

After the publication of his book in 1639 May disappeared from view. Possibly he was swallowed up in the commotions of the Civil War, or perhaps he left England with the Queen's retinue in his capacity of "Physitian extraordinary unto her most Sacred Majesty, *Queen of great Brittany*"—although "Physitian extraordinary" was more in the nature of a title than an office.

A Most Certaine and True Relation of a Strange Monster or Serpent (1639)

" It is an ostent and prodigy, strange and incredible which I am to paint " — thus May introduced his book, dedicated to the Earl of Dorset " as a publike obligation . . . You have honoured me before the Noble Peeres, and highest Councellors of the Kingdome: You have otherwise done me reall favours." It was written in the form of a letter to Sir Theodore Turquet de Mayerne, their Majesties' principal physician, in return for "many favours," particularly "your private, sweet, most familiar and long Colloquies with me."

The book gives an account of how on October 7, 1637, May was asked to examine the body of John Pennant aged 21, of the " writing profession," who had died the night before after an illness lasting three years. His mother, who had been May's patient for "the Stone," was anxious to discover the cause of her son's illness and death. His symptoms pointed to urinary tract disease and he had also " complained of his breast . . . and was subject to palpitations." In accordance with current practice, May as a physician did not deign to perform manual operations such as a postmortem himself. Therefore he " sent for Master *Jacob Heydon Surgeon* . . . who with his Man-Servant came unto me: And in a word we went to the house and Chamber where the dead man lay." At May's direction " the naturall Region " (abdomen) was opened first: " We . . . found the bladder of the young man full of purulent and ulcerous matter: The upper parts of it broken, and all of it rotten: The right kidney quite consumed, the left tumified as big as any two kidnies, and full of sanious matter: All the inward and carnose parts eaten away & nothing remaining but exteriour skins." The remaining viscera were healthy.

" We ascending to the Vitall Region [thorax], found the Lungs reasonable good, the heart more globose and dilated, then long; the right Ventricle of an ashe colour shrivelled, and wrinkled like a leather purse without money, and not any thing at all in it: the *Pericardium* . . . was quite dried also: The left Ventricle of the heart . . . as hard as a stone, and much greater then the right: which upon the first sight gave us some cause of wonder, seeing (as you know) the right Ventricle is much greater then the left [*sic*]: Wherefore I wished M. *Heydon* to make incision, upon which issued out a very great quantity of blood; and to speake the whole verity, all the blood that was in his body left, was gathered to the left Ventricle, and contayned in it." But as the heart continued " of a strange greatnesse and hardnesse . . . I desired him to cut the Orifice wider: by which meanes we presently perceived a carnouse substance, as it seemed to us wreathed together in foldes like a worme or Serpent, the self same forme expressed in the first *Iconography* [Fig. 2]: at which we both wondred, and I intreated him to separate it from the heart, which he did, and wee carryed it from the body to the window, and there layed it out, in those just dimensions which are here expressed in the second figure [Fig. 3]. The body was white of the very colour of the whitest skin of mans body: but the skin was bright and shining, as if it had beene varnished over; the head all bloody, and so like the head of a Serpent . . . The thighes and branches were of flesh colour, as also these fibraes, strings, nerves, or whatsoever else they were . . . I searched all parts of it to finde whether it were a pituitose and bloody Collection, or the like: Or a true organicall body, and Conception: I first searched the head and found

it of a thicke substance, bloody and glandulous about the necke, somewhat broken, (as I conceived) by a sudden or violent separation of it from the heart, which yet seemed to me to come from it easily enough. The body I searched likewise with a bodkin betweene the Leggs or Thighs, and I found it perforate, or hollow, and a solid body, to the very length of a silver bodkin, as is here described: At which the Spectators wondered. And as not crediting me, some of them tooke the bodkin after me, made triall themselves, and remained satisfied, that there was a gut, Veine or Artery, or some such Analogicall thing that was to serve that Monster for uses naturall" (*i.e.* as an alimentary canal).

May departed leaving "this strange and monstrous Embryon . . . this new and rare Spectacle in the charge of the Surgion, who had a great desire to conserve it, had not the Mother desired that it should be buried where it was born; saying and repeating, *As it came with him, so it shall goe with him*: Wherefore the Mother staying in the place departed not till shee had seene him sow it up againe into the body after my going away . . . And thus this History had alwayes beene buried from the World, (the Mother having thus buried the Creature) if your selfe [Sir Theodore de Mayerne] and others had not desired a figure and narration of it, which caused me to take the hands, and mindes of some of them who were present . . . Which from themselves and under their hands, here I have done" (see May's legend, Fig. 3).

The rest of the book is taken up by discussion of "how this Monster or such as this should be begotten or bred in the heart, so defended, as hath beene said, more then all the body, and in the most defended part of the heart, the left Ventricle three times thicker of flesh and substance then the right? as also of what matter? . . . both for the manner of their generation and the way of their cure, and by what means such rare and incredible causes of death may bee found out in time and taken away."

May versus Harvey

May believed that "this Worme was at least of three years growth, for so long he complained of his breast," and that during all this time "the whole blood betooke it selfe into the heart" to nourish it. This seemed to him irrefutable evidence against the circulation, and hence also against Harvey's explanation of the pulse. But because of his contempt for these new fangled ideas or because he thought them of too little consequence, he did not deign to mention Harvey by name—perhaps the reason why May's place in the history of the circulation of the blood has been overlooked. May wrote:

"Here those men may be handsomely questioned (who say that the pulse is nothing else but the impulse, of blood into the Arteryes or the Systole of the heart) what was become of the pulse in this man all the while that the whole blood betooke it selfe into the heart, here was either a living man without pulse, or pulse without the Systole of the heart. For what could the arteryes receive where nothing was to be received? or how could there be pulse where was no impulse into the arteryes? The pulse then doubtlesse is from another cause, and is a farre other matter then most men conceive: for there are in a sound man 4450 pulsations in an houre, in a sicke man sometimes in some percute fevers and diseases above 35600, and more, which cannot be from so many severall expressions and receptions of blood; for it is impossible the heart should make compression, and the arteryes apertion, so often in that space"—and so on. Finally May claimed to have written a fuller confutation "in my 3, Booke *De Febribus*." This it has not been possible to trace, and probably it was never published. However, May's statement shows how seriously he was concerned to refute Harvey.

Was the Serpent a Plant?

In a letter dated Naples, 1 March 1640, Severinus sent his correspondent in England, John Houghton, M.D., "many sincere thanks" for the courtesy of his "exceptional communication" regarding "the multifid worm generated in the left hollow of the heart . . . entirely unknown till now to anatomical observation . . . This is indeed a thing worth hearing of, to say the least, and deserving of serious study on the part of investigators of nature." After discussing the possibilities of the creature at length and "after giving this matter much thought . . . I have come to a rather unexpected conclusion . . . Although one would naturally reason that a being of that sort should be classified

as a sentient creature, yet I believe it should be put in the category of plants . . . it is against nature for a mobile animal to be introduced into the highest visceral throne, whereas a stationary, immobile one would be less vexatious . . . the bifid shape, subdividing into many branches posteriorly, exactly fits the character of a plant, but is unlike a worm . . . a hollow structure . . . is not suggestive of any animal . . . But why do we not consult your great Harvey, that pillar of England as well as of medicine and anatomy? To him then I turn over the entire problem—in which case, please disregard everything I have said."

Harvey Consulted

In his next letter dated 8 August 1640, Severinus thanked Houghton for having consulted Harvey: "Thank you very much indeed for writing me the learned Harvey's opinion concerning the anguiform body found in the heart of a man at autopsy. For my part, I did not have the temerity to wish to depreciate the story and the authority of your countryman. I only went so far as to suggest that it was a plant rather than a worm. Now that I hear, however, that Harvey, like myself, has observed those deposits lining the ducts of the heart throughout, believe me, I derive great pleasure from the fact that I seem to have hit upon the same theory and explanation as that remarkable man." However, it appears that he was not altogether convinced by Harvey's explanation, for he went on to ask Houghton to send him a copy of the book if still available: "I should have liked to translate it from the English . . . every one is very anxious to see this work, which has already been made famous by your friends in the whole city of Naples and many of the towns of its jurisdiction."

Five years later Severinus had reverted to his old beliefs, for he wrote to Houghton that the second edition of his most famous book *De Recondita Abscessuum Natura*—the first illustrated text on surgical pathology (Long, 1929)—had appeared (Frankfurt, 1643) "revived and improved with many additions; and particularly improved in that it is ornamented with the mention of your most illustrious name, in connexion with the case of the cardiac worm, a picture of which has been inserted and your letter describing it, reproduced." The chapter devoted to May's serpent was headed *Historia mirabilis bifidi flagellosi in laevo cordis sinu reperti*, and its discoverer described as "a man distinguished in all branches of the medical art."

May, Riolan and Harvey.

To this book Riolan (1648) referred his readers for further details of May's serpent as the most complete account in Latin: "*historiam leges apud Aurelium Severinum.*" The serpent was, of course, grist to Riolan's mill in his attempts to disprove Harvey: "Harvey . . . will have it that all the blood passes from the right to the left side of the heart by way of the lungs, and he denies that any is transmitted through the [interventricular] septum . . . But this I cannot admit, and I shall show the impossibility and impracticability of it in another place." For instance, what about the well-known fact that "the ventricles are frequently obstructed . . . as and when they are filled with fleshy or fatty bodies, by which the heart is suffocated and the circulation of the blood is cut off?" What is more, "Even worms may be generated in the heart . . . Memorable is that history of the Englishman whose heart was gnawed by a worm: you may read the account in *Aurelius Severinus.*" It is interesting to note how the story was embellished as it spread abroad: by the time the serpent had reached Paris it was not only growing in the heart but actually eating it away!

Riolan had visited London in 1639 with Marie de Medicis, mother of Queen Henrietta, and quite likely he and May had met as physicians to mother and daughter respectively. Certainly Riolan met Harvey and the two "had several conversations on the subject of the circulation" (Willis, 1878). Hence perhaps Harvey's undiminished if charitable regard for Riolan, when he received a presentation copy of his *Encheiridium anatomicum* (1648) containing the story of the serpent in the heart. "We may pardon this distinguished individual," wrote Harvey (1651), "that he, so well skilled in anatomy as he is, should obstinately contend against a truth illustrated by the clearest light of reason. This surely is argument of his envy—let me not call it by any worse name. But, perhaps we are still to find an excuse for Riolan, and to say, that what he has written is not

so much of his own motion, as in discharge of the duties of his office, and with a view to stand well with his colleagues. As Dean of the College of Paris, he was bound to see the physic of Galen kept in good repair, and to admit no novelty into the school."

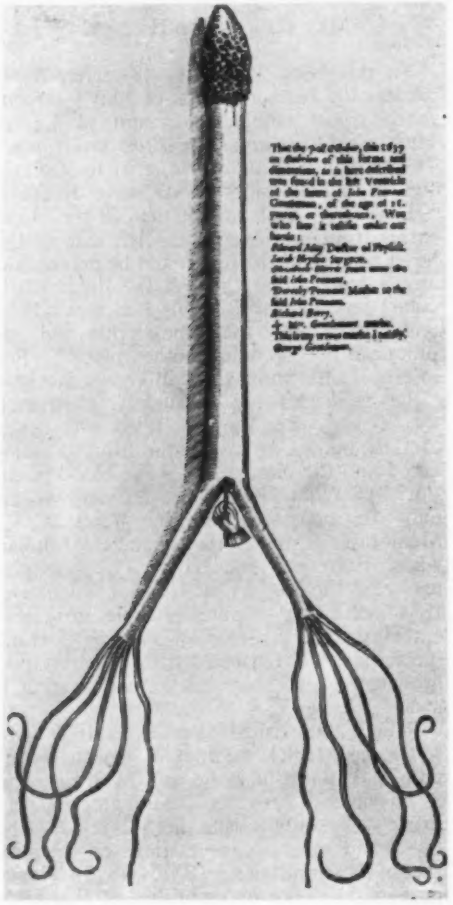

Figure 3. *The serpent laid out after its removal from the body. The caption reaas:*

"That the 7 of *October*, this 1637 an *Embrion* of this forme and dimentions, as is here described was found in the left Ventricle of the heart of *Iohn Pennant* Gentleman, of the age of 21 yeares, or thereabouts. Wee who saw it testifie under our hands: *Edward May* Doctor of Physick. *Iacob Heydon* Surgeon. *Elizabeth Herris* Aunt unto the said *Iohn Pennant*. *Dorothy Pennant* Mother to the said *Iohn Pennant*. *Richard Berry*. + Mrs. *Gentlemans* marke. This is my wives marke I testify. *George Gentleman*."

It is a chastening reflection on the credulity and temper of "scientific" or medical thought that while Harvey was bitterly attacked, May's serpent carried all before it. And such was the quality of the opposition to Harvey which caused him to say "that after his booke of the Circulation of the Blood came out, that he fell mightily in his practice, and that 'twas beleeved by the vulgar that he was crack-brained; and all the physitians were against his opinion, and envyed him" (Aubrey).

Discussion

When we first studied May's book we were inclined to believe that the serpent in the left ventricle was a rare case of embolism from the bifurcation of the interior vena cava reaching the left ventricle through a patent foramen ovale — because like all other commentators we accepted May's statement that the worm was found in the left ventricle. Had this been so, May's serpent would have antedated Cohnheim's (1877) description of paradoxical embolism by almost two hundred and fifty years. Fortunately, we took the precaution of seeking advice from a pathologist familiar with the examination of cadavers.

The protracted illness from which the young man suffered was chronic pyelonephritis and cystitis, perhaps superimposed on a congenital abnormality of the genito-urinary system: "the right kidney quite consumed" might mean that it was congenitally absent.

Regarding the serpent, it is not uncommon to find objects of this shape and colour in the heart at postmortem (Fig. 4). When such postmortem thrombi are present in the undisturbed body they lie in the pulmonary trunk extending into the pulmonary arteries and main branches in one direction, and in the other through the pulmonary valve into the right ventricle. That part of the clot lying in the pulmonary trunk resembles the body of this worm in shape, and being composed of fibrin is often "white . . . bright and shining," although it may be partly yellow in colour, hence its other name chicken-fat thrombus. The portions in the pulmonary arteries and branches are reddish — "the thighes and branches were of flesh colour, as also all these fibraes, strings, nerves or whatsoever else they were" — because in a reclining body they lie at a lower level than the pulmonary trunk so that the corpuscular

elements of the blood settle in them. There is a constriction at the point of the pulmonary valve — " the necke "; and beyond it a larger red mass — " the head all bloody, and so like the head of a Serpent " — which *in situ* occupied the pulmonary infundibulum. Such clots are solid and rubbery in consistency:

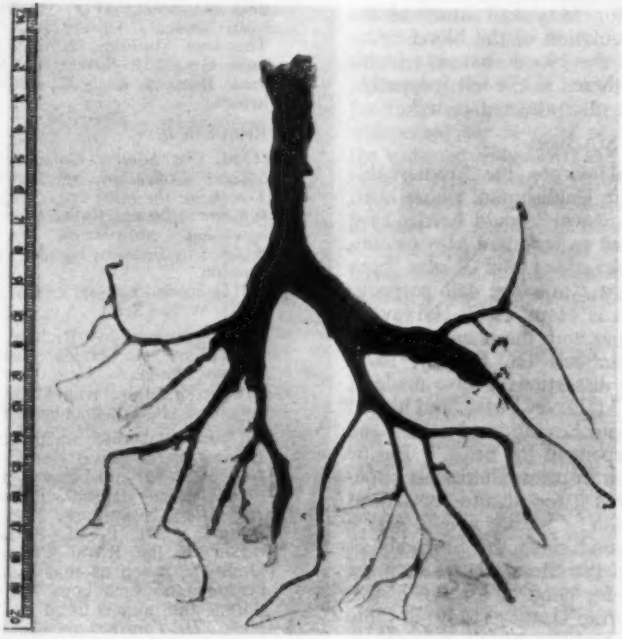

Figure 4. *Cardiac 'serpent' from an autopsy performed* 23 *April,* 1957.

that May found it " perforate, or hollow " can only be explained by his creating a channel through it when he " searched " its " body with a bodkin between the Leggs or Thighs " (Fig. 3).

Since this was a postmortem thrombus and not adherent to the vessels in which it lay, it is easy to understand how when the blood was allowed to escape from the engorged right ventricle, the clot slid down into its cavity, perhaps encouraged by the surgeon's manipulations. There it appeared to May as a coiled serpent (Fig. 2) which had grown and lived in the heart " which yet seemed to me to come from it easily enough."

" The right Ventricle of an ashe colour shrivelled . . . and not any thing at all in it " was of course the empty left ventricle. Indeed, May throughout his account confused right with left ventricle: this is quite evident from his surprise at finding the left ventricle of the heart so large, " seeing (as you know) the right Ventricle is much greater then the left." A glance at his drawing of the heart (Fig. 2) shows that he had only the most primitive anatomical notions.

Harvey certainly was not deceived by May describing the serpent as inhabiting the left ventricle, just as he was not deceived by its nature. In *De Motu Cordis* he had already demonstrated the cause " wherefore in our dissections we usually find so large a quantity of blood in the veins, so little in the arteries; wherefore there is much in the right ventricle, little in the left; circumstances which probably led the ancients to believe that the arteries (as their name implies) contained nothing but spirits during the life of an animal " (Harvey, 1628). When Riolan revived this old argument against Harvey's circulation of the blood, Harvey (1649)

repeated in his reply that the phenomenon " is caused by this, that when respiration ceases the lungs collapse . . . the heart, however, continues for a time to contract upon the blood, whence we find the left auricle more contracted, and the corresponding ventricle, as well as the arteries at large, appearing empty." Perhaps Harvey stressed this point because he had in mind Riolan's mention of May's serpent, for May had attached his attack on the circulation of the blood to his finding that " all the blood that was in his body left, was gathered to the left [properly: right] Ventricle and contayned in it."

SUMMARY

Morgagni (1761) wrote, the " remarkable history of a certain Englishman, whose heart was gnaw'd by a worm " could hardly have arisen and survived so long had May or eminent men like Severinus and Riolan been familiar with what " now we call polypous concretions," that is blood clots. Harvey, of course, was familiar with the phenomenon of postmortem thrombosis (cf. Harvey, 1628) " from the many dissections I have made of persons diseased " (Harvey 1649), and he had at once and without hesitation identified and rejected " the Serpent in the heart." But he never referred to it in print. Unlike his opponents he considered it too absurd for serious scientific discussion: " scarce a day, scarce an hour, has passed since the birth-day of the Circulation of the Blood, that I have not heard something for good or for evil of this my discovery " wrote Harvey (1649) in reply to Riolan, with perhaps May's monster in mind. " To return evil speaking with evil speaking, however, I hold to be unworthy in a philosopher and searcher after truth . . . It cannot be helped that dogs bark . . ."

ACKNOWLEDGMENTS

We thank Dr. William Blackwood, Pathologist, The National Hospital for Nervous Diseases, Queen Square, for advising us on the nature and provenance of Dr. May's serpent. We owe the " serpent " in Fig. 4 to the kindness of Dr. R. McD. Anderson of the Department of Pathology, and Mr. A. H. Prickett of the Photographic Department of the same hospital.

THE WRITINGS OF EDWARD MAY.

1. May, E. (1633). *Epigrams Divine and Morall.* London. 38 ll.
2. —— (1639). *A most certaine and true Relation of a strange Monster or Serpent found in the left Ventricle of the Heart of John Pennant, Gentleman.* London.
   Entered in the registers of the Stationers Company, 14 October, 1639 (Arber, E. (1877) *A Transcript of the Registers of the Company of Stationers of London.* Vol. 4, p. 457).
   Collation and Contents: A1a title; A1b blank; A2a-A2b " To the Right Honourable Lord and highly renowned Peere of this Kingdome, Edward Earle of Dorset . . . Edward May wisheth all health and glory "; A3a " A preface to the Reader "; A3b " The Contents " and Errata; A4a " the first Iconography " (Fig. 2); A4b blank; inserted before B1 a folding engraved plate " the second figure . . . Place this next the heart " (Fig. 3); B1a-F4b Text (pp. 1-40) headed " To the Right Worshipfull Sir Theodore Maiherne Knight, Chiefe Physitian unto His Most Soveraigne Majesty, King of great Brittany, &c. Edward May wisheth all health."

   Reprinted in:

   (1750) *The Somers Collection of Tracts. A Second Collection of Scarce and Valuable Tracts, on the most interesting and entertaining subjects: But chiefly such as relate to the history and constitution of these kingdoms.* Revised by Eminent Hands. Vol. 2, pp. 423-441. London.

   (1811) Second edition, augmented and arranged by Sir Walter Scott. Vol. 5, 558-572. London.

   Latin epitome by Richard London, M.D., quoted by P. Servius (1642); reprinted in Rattray (1662).

   Another by John Houghton, M.D., quoted by Severinus (1643) with plates.

   An edition of 1685 noted in *Catalogue of the Library of the Royal College of Physicians of London* (1912) and listed by D. Wing in *Short-title Catalogue of Books Printed in England . . . 1641-1700* (New York, 1948) is apparently a " ghost." Mr. L. M. Payne, Assistant Librarian of the Royal College of Physicians, kindly informed us that as far as can be ascertained no such copy has ever been in the library and none is listed in any other.
3. ——. *De Febribus* mentioned by May (1639) as " my 3, Books " has not been traced and was probably never published.

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SPORTS NEWS

READERS MAY wonder or delight at the lack of sporting news in this month's issue. However, in order to do full justice to Dr. Harvey (not, by all accounts, much of a sporting gentleman) on this, the tercentenary of his death, we must strictly ration our accounts of purely physical and non-academic feats. Should there be any who automatically turn to the end of the JOURNAL for their literature, to them we can only offer condolences and the promise that the July issue will attempt to catch up on what has gone before.

One cannot, however, refrain from congratulating the rugby club on reaching Twickenham for the second successive year in the Middlesex Seven-a-side Competition. That the London Hospital also achieved this (at any rate for this year) is merely a fair reflection that both sides reached the Cup final on merit. Although the hospital went down 8—3 to the eventual winners, St. Luke's College, Exeter, perhaps their moment of glory was at Beckenham after convincingly defeating London Scottish. A precedent has now been established — a Mary's professor has conceded that we can play rugby, and it is up to future captains to ensure that it is not allowed to lapse.

After the hustle of the winter rough and tumble, the summer sports have arrived in pleasant somnolence and in weather ideal for their enjoyment. The preclinicals, it is whispered, are accused of apathy in joining the summer clubs. Perhaps they are accused of this every year, perhaps secretaries get a bit touchy with the unaccustomed heat, but if there is any justification, perhaps the Charterhouse members will make themselves known to secretaries of any activity in which they are interested.

CRICKET

1st XI v. London House. At Chislehurst on Sunday, 28 April. Won by 3 wickets.

Bart's: 123 for 7 (Pagan 35, Stark 25, Harvey 20).
London House: 117 (Gissing 65, Nichols 5-32).

The season's opening match was viewed with some trepidation, as very few of last year's regulars were available. However the Hospital won by 3 wickets in the last over but one, and so started things off on the right note.

The London House innings opened to a good seam attack from Garrod and Harvey, both of whom frequently beat the bat without getting a touch. Apart from a fighting 65 by their opening batsman, the remainder showed little determination, and intelligent bowling by Nichols kept the runs down towards the end of the innings. The Hospital fielding had worn an early season look; several catches and half chances were put down. There is room for much improvement in this department, which one hopes will be forthcoming as the weather gets warmer.

Bart's had thus been set 117 runs in 105 minutes, and with a fine opening stand by Stark and Pagan put on 56 for the first wicket. In spite of the more illustrious batsmen that followed holing out in an effort to force the pace, the game was won with three minutes to spare. Perhaps this margin would have been larger if the lady scorer had added the extras to the total during play, rather than when everything was all over!

ERRATUM

We apologise for a mis-print which occurred in the April edition of the *Journal* in the section on Golf. For Mr. Hartley please read Mr. Hankey. We would like to apologise to this gentleman in particular and to the Golf Club in general for any inconvenience caused.

SOME REFLECTIONS OCCASIONED BY ANOTHER HARVEY TERCENTENARY

by A. W. FRANKLIN

ONE OF THE most touching scenes in the History of Medicine is that painted by George Ent in the introduction to Harvey's great book on "Generation." It was Christmas, 1650. England had been riven by the Civil War and Harvey's old master, the King, had been beheaded but a few months before. Ent had gone out to see the great man, then in his seventy-third year, hoping to secure the manuscript of "De Generatione" from its modest author. Harvey spoke of the discovery of the circulation: "You know full well what a storm my former lucubrations raised. Much better is it oftentimes to grow wise at home and in private, than by publishing what you have amassed with infinite labour, to stir up tempests that may rob you of peace and quiet for the rest of your days." But he is persuaded, presents Ent with his papers on "the generation of animals," and Ent returns in triumph to the City "feeling like another Jason laden with the golden fleece."

In the recorded conversation Harvey, while explaining the need to re-examine natural objects as the boundaries of knowledge and of the known world widen, refers to the ancients as "our authorities in science." "The examination of the bodies of animals," he has just confessed, "has always been my delight, and I have thought that we might thence not only obtain an insight into the lighter mysteries of Nature, but there perceive a kind of image or reflex of the omnipotent Creator himself." So Harvey acknowledges the authority both of God and of the Greeks and reveals himself as a man of peace only concerned with learning the truth. He tried to observe, freed from prejudice, from "l'idée preçoncu" and then gathering his observations together to deduce the cause. He possessed freedom of mind, clarity of thought, the seeing, accurate eye, patience, concentration and an aim. He was determined to understand the movement of the heart and of the arteries. He must discover the truth about this pulsation that was such a feature of life. He saw it in all God's creatures that he could collect and study by observation, by dissection, and by using, as he did with wasps, hornets and gnats "an optick glass made for the discovery of the least things." But Harvey was also the first of the modern experimental scientists. He owes his place in medical history to his success in revealing truth. He saw himself as a builder in the tradition of Greek thought; but while he accepted Greek thought he felt in no way bound by Greek thoughts. The acid test was their ability to explain what he had himself observed. And to test his own conclusions he tries to alter the situation, to plan experiments to show that under these artificial circumstances his observations are still explained by the idea that the blood circulates. In his enthusiasm to discover the truth he conducted successful experiments and so advanced from search to research. As Osler wrote in his Harveian Oration, Harvey ushered in "the age of the hand — the thinking, devising, planning hand, the hand as an instrument of the mind."

We have long forgotten who invented the wheel — that innovation which has opened up the world and on which so much of the world's material progress has moved. Had the inventor written a book about it and had the book survived, it would be worth untold gold, but we should not need to read the book to admire the author or to use the wheel. Harvey is not quite a household name, but many have heard that he was a famous doctor. To not a few he is known as the man who discovered the circulation of the blood. In each century come three Harvey centenaries, of his book *De Motu Cordis* in 1628, of his death in 1657, and of his birth in 1578. Each year the Royal College of Physicians celebrates his benefactions in an oration on St. Luke's Day. No-one enjoying these ceremonies need read the fixed Latin 72-paged quarto printed in Frankfurt on poor

Dr. A. W. Franklin, M.A., F.R.C.P., is Physician to the Children's Department. He is a founder member and Treasurer of the Osler Club of London, and has edited selected writings of Sir D'Arcy Power and Sir William Osler. He also once edited the *Journal*.

crumbling paper that made its slow way like a ship under sail, though driven by contrary winds and shot at by enemy ships on its voyage, to drop its cargo of truth in the world's ports. Yet how readable the book is in its English translation, although in three hundred years words and ideas have changed much in value and in meaning. If Shakespeare needs a glossary of Elizabethan usage, how much more does Harvey, who learned and reverenced the ancient authorities. He was satisfied to walk warily through argument, opinion and observation, doffing his cap where he begged leave to differ, polite, considerate, gathering such fragments of the truth as he could recognise, adding his own, testing his conclusions by experiment and coming at the last to truth.

What a long hard journey to reach so simple a matter as the truth about the circulation of the blood. The twentieth century looks back without sympathy at the impact of this truth upon Harvey's contemporaries, at the refusal by the University of Paris to accept the new teaching for half a century, when we could be persuaded of a new truth every half an hour. We would each like to suppose that we at least had we lived at the time would have recognised greatness and acclaimed the new discovery. We would like to think that among the moderns Harvey would be Nobel prize winner, Reith lecturer, O.M., sent on international lecture tours by the British Council. In fact his contemporaries behaved as all good contemporaries do. Where new-found truth follows established truth and has been reached, be the labour never so hard, by established methods, contemporary thought can accept it. But contemporaries have a nose for the scent of revolution and, on the whole and in the mass, they don't like it.

Here was a man, trained to accept authority and revelation as the channels through which truth flowed, using his eyes and setting up his own intellect against the accumulated intellects of the centuries. Does not Hippocrates teach that experience is deceitful, and yet one man's experience has to count for so much. And worse, he does experiments, and an experiment is not even experience. He measures, only with his eye, but still he measures the time relation of the systole of the ventricle to the systole of the arteries; he measures the amount of blood lost from an animal's body when a vein is severed. From these measurements he draws revolutionary conclusions. This is all so unsettling, and one has to ask "where will it end?" If ancient techniques of thought could lead so far away from a central truth like this, what other errors are there? Harvey, a solid man, physician to the person of a Majesty who upheld the Divine Right of Kings, physician to a great and ancient Hospital in a great and ancient City, is a revolutionary. He had and he deserved a revolutionary's treatment.

In his own lifetime "to stir up tempests" was the last thing he intended. What has the quiet contemplation of nature, the observation and the dissection of the bodies of animals, to do with tempests? The key is to be found in the effect of truth upon the human mind. Harvey searched diligently for truth and in so doing proved himself exceptional. His contemporary Galileo, who revolutionised the Universe as Harvey Man, wrote, "It is really pitiful that there are so few who seek truth." To the common man truth is difficult to learn, unwelcome, and he speaks of it as dazzling, unvarnished, as naked and unadorned, as if he must turn his eyes away from it. This is what happens with new truth discerned through the arts, with new moral truths revealed by prophets, as well as with the truths proclaimed by scientists. The history of medicine teaches this lesson, how every innovator has been attacked, persecuted, vilified, not only by lay men, but by professional colleagues. The stormy controversies raised by Darwin, by Lister, by Pasteur, by Jenner, by Harvey himself show how small a welcome has new truth in the minds of ordinary men. Truth, even scientific truth, starts a chain reaction, and everyone knows how such reactions end.

Were Harvey alive today he would see no tempests in science in the Western world. A harvest of immeasurable value has been reaped in the practical understanding and treatment of disease, and in the material environment of man.

Our Lares and Penates are science and the pieces of scientific apparatus with which we fill our homes, on which we travel, by which we learn, we teach and we are entertained. Base and ungrateful would men be, not to hold sacred truths so bountiful and so rewarding, and the techniques by which they are attained. Set Harvey down in the modern world with an electron microscope for

his optick glass, and radio-active isotopes for experiment, what results might there not be. Perhaps he would overcome the problems of the measurement of the infinitely small, in which the act of observation and measurement itself causes an error unpredictable and uncontrollable that vitiates results. Or perhaps his truth seeking mind would have busied itself in quite other spheres. In his talk with Ent he confessed a double purpose in his dissections: to gain "insight into the mysteries of nature" and this mankind has deepened and broadened following his example. To "perceive a kind of image or reflex of the omnipotent Creator Himself": where and how would William Harvey have searched for this today?

BOOK REVEIWS

ALCOHOLISM (A Manual for Students and Practitioners) *by* Lincoln Williams. E. & S. Livingstone Ltd. Pp. 62. 8s. 6d.

This slim manual presents a hopeful outlook in the treatment of alcoholics. After a brief survey of the various aetiological factors, and a discussion on the varied modes in which alcoholism may present, the author outlines the methods of treatment available at the present time—from parentrative to group psychotherapy.

This book should be read by all those in, or about to enter, any form of practice in which large numbers of patients are seen—for at least a few are likely to be sufferers from alcoholism, there being about half a million in the United Kingdom.

In a series of short chapters, which make for easy assimilation, most of the information required by the student or G.P. is contained—information which is not readily available outside the specialist monographs.

J. T. S.

WILLIAM HARVEY, HIS LIFE AND TIMES: HIS DISCOVERIES: HIS METHODS: *by* Louis Chauvois. Foreword by Sir Zachary Cope. London, Hutchinson Medical Publications, (1957). 271 pp., illus. 25*s*.

This tercentenary year of the death of William Harvey will result in the publication of numerous tributes to his memory. Many will add nothing to our knowledge of his life, times and writings, and none will attempt the thorough re-evaluation presented in this book. Dr. Chauvois an eminent physician and historian of medicine, has re-examined the Latin texts of Harvey's writings, re-investigated his life history, and prepared a scholarly biography that fills a need at an opportune time.

Dr. Chauvois has obviously spent many years investigating his subject, searching for fresh material at its source, confirming certain details, taking little for granted, but approaching each problem with an open mind. His resultant biography of William Harvey is engrossing, and is published simultaneously in French. It will be valued as an appreciation from a distinguished French historian who has marshalled his facts to the best advantage. Commencing with a chapter entitled "A day with William Harvey, London, 1627," the book then proceeds with the events of Harvey's life in chronological order, followed by chapters devoted to his tomb, will, portraits and relics; his work and texts; the views of his contemporaries and successors; and his work in the light of modern knowledge.

It is impossible to offer any serious criticism of this well-produced volume, although the bibliography and the index are inadequate. On page 40, note 1 contains the misprint "Linnean" for "Linacre"; on page 175, footnote 2 is missing; and on page 176 John Hunter is confused with his brother William. Among a few other minor points for criticism we must mention Dr. Chauvois' reproduction on page 143 of Sir D'Arcy Power's description of Harvey's presence at the Battle of Edgehill, as recorded by Aubrey. More recent information (D. Stewart: Harvey and the Battle of Edgehill. *Brit.med.J.*, 1946, I, p. 808) dismisses this as a fabrication on the part of John Aubrey.

William Harvey, revered at Bart's as our most outstanding Physician of all time, and an historical figure of interest to all medical men, is still a subject worthy of study by modern methods. There remain gaps in our knowledge of his life and work, despite the passage of three hundred years since his death, and Dr. Chauvois has given us an invaluable study that will stimulate further research, in addition to presenting us with fresh light on several aspects of Harvey's life and writings.

JOHN L. THORNTON.

AIDS TO SURGICAL NURSING *by* Katharine F. Armstrong.

AIDS TO TUBERCULOSIS NURSING *by* L. E. Houghton and T. Holmes Sellors. Baillière, Tindall & Cox. 8s. 6d. each.

Both these books are new editions of old favourites in a well known series, revised but not extensively re-written. The one on tuberculosis nursing includes a new chapter on chemotherapy, and the space allotted to excision has quite rightly been trebled. "Aids to Surgical Nursing" includes some modern ideas, such as the inadvisability of warming the patient with shock, but still contains much elderly material which might today be discarded, e.g. the Kekwick and Marriott apparatus for continuous blood transfusion, and Last's electric clock for penicillin injections. The picture on Page 88 is of interest to the older members of this hospital, but is not one that we care to see reproduced now as an example of surgical nursing.

NEW EDITIONS

REFRESHER COURSE FOR GENERAL PRACTITIONERS (Articles from the B.M.J.) 3rd Collection (fully revised). British Medical Association. Pp. 548. 25s.

General practice presents its own particular problems in keeping up with modern knowledge and many hospitals run refresher courses for practitioners, but many doctors are much too busy to attend them—the specialist articles are far too numerous for the field to be adequately covered, and textbooks are notoriously two years behind at least.

A book such as this provides a useful 'fill-in'—the brevity of the articles do not put off the tired G.P., and yet they contain what he wants to know. For the student they are a little short and too particularised.

It is rather expensive for a text which could only be used for sporadic revision by a student; but it could with advantage be borrowed from the library for an evening, when it would provide very up to date and authoritative information presented by doctors with a wide experience of their subject.

AIDS TO DERMATOLOGY 5th ed. *by* R. M. B. MacKenna and E. Lipman Cohen. Baillière, Tindall & Cox. Pp. 312. 10s. 6d.

This is one of the most successful of the 'Aids' series providing an excellent resumé of the commoner disorders of the skin, together with reliable therapeutic methods. Unfortunately, dermatology is a subject which requires more illustrations than most and such are impossbile to produce within the compass of such a small book. If this book were used in conjunction with an atlas of skin diseases no further work need be consulted by the student, or general practitioner.

It is the author's avowed purpose to be consistent in their prescribing; Latin follows English and Metric, Apothecary. I must protest strongly: nothing is more infuriating to one who is trying to live up to the hopes of the forward-looking section of the profession who are attempting to adopt the metric system as the only one employed in medicine. Apart from this 'Aids to Dermatology' is an excellent book.

DISEASE IN INFANCY AND CHILDHOOD 6th ed., by Richard W. B. Ellis. E. & S. Livingstone. Pp. 710. 50s.

A welcome new and up-to-date edition of a readable and reliable text. The illustrations are admirable, especially those in colour which appear for the first time. Each chapter is followed by a useful biblography giving enough references for those wishing to pursue an individual topic further, without cluttering up the book with lists of obscure papers.

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Psyche-cum-soma

Cupid, you will remember, deserted Psyche; and I occasionally wonder whether it was not so much because she asked awkward questions as because he discovered that she was one of a pair of Siamese twins. For though it was easy enough for Cupid to leave Psyche, Psyche, poor girl, can never leave Soma. Yet to their Siamese twinship—the twinship of mind and body—we are often, like Cupid, blind.

Of course in one sense, we know quite well that our minds are constantly influencing our bodies. Suppose I ask you to think of a lemon—to remember how it smells, how it feels when you cut it with a sharp knife, and what it tastes like when you let your teeth sink into it, as we used to do at halftime. Unless you are unusually weak on imagination your mouth will water. But not because I have in fact handed you . . .

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children given at the beginning. The first hundred pages are taken up with general considerations of aetiological factors in disease of children. The rest of the book is arranged into chapters concerned with types of disease and stress is laid on the differences in presentation of patients of varying ages. Any classification must be artificial, but in children, where a lesion in the lung frequently presents with abdominal symptoms any system based on morphological grounds would be more misleading.

Highly recommended.

A SYNOPSIS OF CHILDREN'S DISEASES by J. Rendle-Short. 2nd edition. 632 pages. John Wright & Sons Ltd. 35s.

For those who like the synopsis type of work this second edition of a relatively new book can be heartily recommended. It covers its subject very comprehensively, and the table of drug dosages for children should be of particular value to both House Physicians and General Practitioners. However it must be emphasised that whilst this book is most valuable for reference purposes or for quick revision before final exams it should not take the place of standard textbooks.

C.C.

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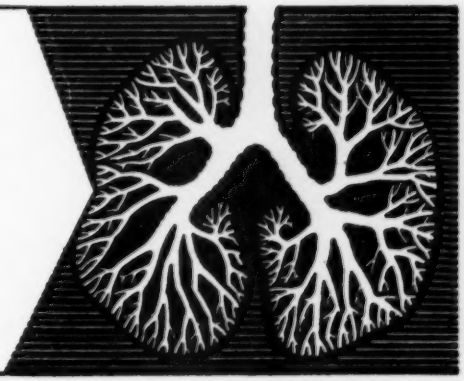

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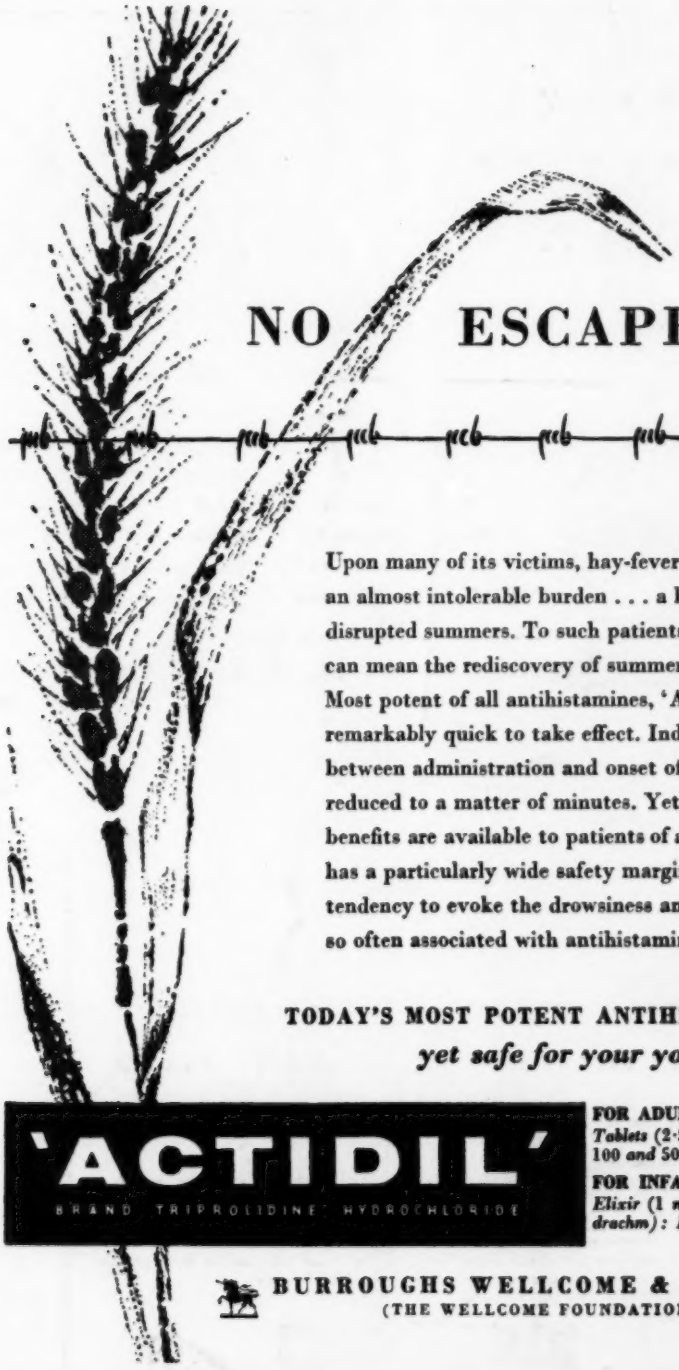

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